Lesson no. 30 Chicory (Kasni)

Common chicory is also known as blue daisy, blue dandelion, blue sailors, blue weed, bunk, coffeeweed, cornflower, hendibeh, horseweed, ragged sailors, succory, wild bachelor's buttons, and wild endive; botanically it is called as Cichorium intybus & belongs to Asteraceae family; it is harvested in many parts of world for its medicinal benefits & commercial & domestic uses.

It is mentioned in Tibb e Nabawi (Prophetic medicine); it is mentioned in Abu-Nuaim a book of Hadith & in these hadith it is mentioned that Prophet Muhammad (s.a.w) said Jannah water is showered on its plant; in other Hadith it is advised to use it without shaking because it is showered by Jannah water; in other hadith it is mentioned that the one who eats it & goes to sleep poison & evil spirits will not affect him. For more Islamic study on it please visit my website www.tib-e-enabi-for-you.com or direct link to my website on its lesson tib-e-nabi-for-you.com/kasni.html or read my English book tibb e Nabawi part 2 lesson 53 page 166 onwards.

- ***NAMES:-***

1. In Hadees it is called as Hindba (الهند باء).
2. In Arabic it is called as Hindba, Bazrullah.
3. In Hindi &Urdu it is called as Kasni.
4. In English it is called as Chicory, Blue daisy, Blue Sailors.
5. In Latin it is called as Cichorium intybus.
6. It belongs to Asteraceae family.

It is mentioned in following books of Hadith (names of book of Hadith & reference are also given) Abu-Nuaim volume 3 page 435; Abu-Nuaim 3659; Abu-Nuaim volume 2 page 5 & At-tibbe-nabawi volume 1 page 314.

- ***Basic encyclopedia of Chicory: -***

Cichorium intybus Linn, family Asteraceae, is commonly known as chicory and is used in Indian System of The genus Cichorium (Asteraceae) consists of six species with major distribution areas in Europe and Asia.

Cichorium intybus is cultivated for numerous applications and can be divided into four main varieties or cultivating groups according to their uses; several varieties are cultivated for salad leaves, chicons, or roots; Chicory can be found in different varieties including Common chicory, Belgian endive, radicchio (Italian chicory), and puntarelle. Common chicory are baked, ground, and used as a coffee substitute and

supplement. It is also grown as a forage plant for poultry and animal; predominantly cultivated in northwestern Europe, India, South Africa, and Chile, produces the taproot as a coffee substitute or for inulin extraction.

"Brussels" or "witloof" chicory is commonly cultivated around Europe as industrial chicory for etiolated buds (chicons) by forcing; "leaf " chicory is used as fresh or cooked vegetables; and "forage" chicory, initially derived from wild chicory commonly found along roadsides and waste areas, has been used since the mid-1970s intensify herbage obtain ability in perennial pastures for livestock.

Historically, chicory was grown by the ancient Egyptians as a medicinal plant. The dried and roasted roots are used as coffee substitutes and additives, young leaves can be added to salads and vegetable dishes, while chicory extracts are used for the production of invigorating beverages. The plant was used traditionally for the treatment of diarrhea, to strengthen the prostate and other reproductive organs, for the treatment of pulmonary disease and cough, cancer, hangover, for purification of biliary tract, liver complaints, as spasmolytic, to relief of symptoms related to mild digestive disorders (such as feeling of abdominal fullness, flatulence, and slow digestion) and temporary loss of appetite. It is internally used for sore throat, hemorrhoids, tuberculosis, abdominal cramps, melancholy, deafness, rashes and as laxative for children.

- ***Chicory plant: -***

Chicory (Cichorium intybus) is a perennial herbal plant of the dandelion family Asteraceae, usually with bright blue flowers, rarely pink or white. It is 40-110 cm tall, perennial, with a strong taproot. Stem are usually solitary, erect; branches spreading ascending, sub-glabrous. Leaves are basal rosulate, obovate to oblanceolate, 15-34 × 2-4 cm, attenuate into a petiole like basal portion, undivided to usually runcinately pinnatipartite, sparsely covered with long multicellular hairs, base attenuate, margin dentate; lateral lobes 3-6 pairs, triangular; terminal lobe distinctly larger than lateral ones; flowers are deep sky-blue; capitate flower and diameter is about 3-4 cm, and has a brilliant bluish-purple (sometimes pink or white), radially symmetrical bloom. Flowers are singularly arranged along the length of a fibrous and rigid, dark-green stem. This wildflower has two types of leaves: large-dandelion shaped leaves near the base of the stem and small lanceolate-to-oblong-shaped leaves along the length of the stem.




- ***pH of it: -*** Is not known.

- ***Calories of it: -*** 100 grams of raw root gives 72 calories.

Glycemic index & Glycemic load: - it is low GI & GL due to inulin content in it; chicory root fibers like inulin and oligo-fructose are not digested by human enzymes, making them unavailable for glucose release into the blood stream, ensuring that their consumption does not raise blood glucose levels. Chicory root fibers serve dual purposes: in addition to lowering blood glucose. And inulin is Low glycemic index and load. The reported GI value is 14 for native inulin and 5 for commercial long-chain inulin.

A food is considered to have a low Glycemic index (GI) if it is 55 or less; mid-range GI if 56 to 69 & high GI if 70 or more. *Glycemic index* is a number. It gives you an idea about how fast your body converts the carbs in a food into glucose.

A low Glycemic load (GL) is between 1 and 10; a moderate GL is 11 to 19; and a high GL is 20 or higher. For those with diabetes, you want your diet to have GL values as low as possible.

The *glycemic load* (GL) of food is a number that estimates how much the food will raise a person's blood glucose level after eating it. *Glycemic load* accounts for how much carbohydrate is in the food and how much each gram of carbohydrate in the food raises blood glucose levels.



- ***Gross health benefits of : -***

It is cardiotonic, anti-inflammatory, digestive, stomachic, liver tonic and diuretic. The phytoconstituents are distributed in the whole plant. These are sesquiterpene lactones, lactucin, 8-deoxylactucin, lactopicrin, cichoriolide A, B and C. It is harvested in many parts of the world for its medicine purpose & to use for pets specially chicken; it is also eaten raw as salad & cooked and eaten.

In addition, chicory herb plays a key role as antioxidant, anti-inflammatory, sedative, immunological, productive and reproductive enhancer, cardiovascular, hypolipidemic, anticancer, anti-protozoal, gastro-protective, antidiabetic, analgesic, anthelmintic, antimicrobial, wound healing and bitter tonic without inducing therapeutic adverse effect. It has hepatoprotective activity; chicory extract reduced the levels of hepatic enzymes such as alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP). Also, chicory plant is a good and very important protective source for hepatocytes and other liver cells as well as it is used as prebiotic against some species of pathogenic bacteria for both in vitro and in vivo. Moreover, it enhances immunity and feed efficiency by decreasing pathogenic microorganisms of gastrointestinal tract. Its roots also can be used for the relief of mild digestive disorders, such as feeling of flatulence, abdominal fullness, temporary loss of appetite and slow digestion. The present review highlights the importance of chicory as a feed additive used to improve growth and productive performance of poultry as well as salient beneficial applications in animals and humans. Furthermore, it explains the mechanisms of action underlying the beneficial effects of chicory and to find the effective level in poultry that would act as liver tonic.

Plant part	Traditional uses
Aerial decoction	Liver disorders, spasmolytic, cholesterol, antiseptic
Chicory seeds	Liver disorders
Root	Jaundice, liver enlargement, gout and rheumatism cough relief
Whole plant	Eupeptic, stomachic, depurative, choleretic, laxative, hypotension, tonic and antipyretic
Leaves	Blood cleansing
Leaves	High blood pressure and blood purification
Leaves/roots	Arteriosclerosis, anti arthritis, antispasmodic, digestive
Whorls	Depurative
Leaves	Choleretic, hepatoprotective against jaundice, mild laxative, hypoglycemic
Aerial/roots	Renal disease
Whole plant	Kidney disorders and diabetes
Roots	Diabetes
Flower	Diarrhea
Aerial part/root	Cholagogue, digestive and hypoglycemic
Leaves, stems, roots	Jaundice and tonic
Leaf	Wound healing
Aerial	Hemorrhoids, urinary disorders

- ***Parts used:-*** Aerial part, flowers seeds and roots.
- ***Clinical pharmacology of it: -***

Chicory root contains some phytochemicals such as inulin (starch-like polysaccharide), coumarins, flavonoids, sesquiterpene lactones (lactucin and lactucopicrin), tannins, alkaloids, vitamins, minerals, and volatile oils. The secondary metabolites (flavonoids, tannins, and coumarins) found in chicory have been reported to demonstrate some biological activities such as antioxidant, anticancer, anti-inflammatory, antiparasitic, anti-hepatotoxic, which impact positive health effect on humans and livestock. Inulin is a polymer of fructose with *β*-(2-1)-glycosidic-linkage, which accounts for up to 68% of the total compounds present in fresh chicory roots. As a prebiotic, inulin is low in calorie and dietary fiber, making it a good replacement for sugar and an ideal component for diabetic nutrition.

Furthermore, animal performance on forage chicory is similar to that of legumes and superior to grass-based pastures; chicory increases milk production when offered as a supplement to pasture. As reported elsewhere, grazing chicory is known to decrease some internal parasites in livestock and therefore has potential to reduce the use of anti-helmintic.

It has very common phyto-compounds like phenolic acids, which include chlorogenic acids, and flavonoids (anthocyanins, flavonols, flavanone, and flavan-3-ols). The plant polyphenols usually occur as glycosides, which makes them less reactive and easier to store in the cell vacuole. Cleavage of the glycosidic-linkage and associated rearrangement reactions releases the following sugar residues: hexose, glucose or galactose, deoxyhexose, rhamnose, pentose, xylose or arabinose, and glucuronic acid. The anthocyanins have been reported to reduce the risk of coronary heart disease in animals by exhibiting arterial protection, inhibition of platelet aggregation, and protection of endothelial tissues.

Many researchers noted that fresh chicory roots contain, by dry weight, 68% of inulin (a polysaccharide similar to starch), 14% sucrose, 5% cellulose, 6% protein, 4% ash, and 3% other compounds. These researchers also noted that dry chicory root extract contains, by weight, approximately 98% inulin and 2% of other compounds.

A study by Soobo (2005), also agreed that chicory root is high in inulin-type fructan and oligo-fructose. Chemically, inulin is a polydisperse-(2,1)-fructan and can be converted to fructose and glucose by hydrolysis. Chicory contains affluent quantities of fructose (up to 94%), which is a long chain carbohydrate, consisting of 22–60 fructose molecules with a terminal glucose molecule. High quantities of sesquiterpene lactones, such as lactucin, 8-deoxylactucin, lactucopicrin, and 11ß-dihydro-derivatives, are hugely responsible for their bitterness. This was confirmed by some researchers, who isolated sesquiterpene lactones, a (+)-germacrene from chicory roots. According to a study by, roasted chicory roots contain various compounds like 2-acetylpyrrole, furfural, phenyl acetaldehyde, phenyl acetic acid, vanillin, pyrazines, benzothiazoles, aldehydes, aromatic hydrocarbons, furans, phenols, organic acids, and small quantities of insole alkaloid (ß-carbolines), harmane and norharmane. Chicory root extract, produced by

removing the insoluble fraction of milled dry root in water by filtration and centrifugation, contains volatile oils, fatty acids, alkaloids, triterpenes, flavonoids, latex, tannins, and saponins. Three new benzo-isochromenes (Cichorins A, B, and C) were isolated from chicory roots. According to these researchers, the roots also contain tannins, fatty acids (mostly palmitic and linoleic), pectin, α-lactucerol (taraxasterol), cichoriin (esculetin-7-glucoside), sugars (especially fructose and mannose), fixed oils, choline, and others.

Chicory seeds contain a rich potpourri of nutrients ideal for both ruminant and mono-gastric nutrition. Ying and Gui (2012) stated that most varieties of chicory seeds have high amounts of crude protein which is more than 19% of the dry weight and 1.6–2.4 times higher than the value in most conventional grains, like wheat, rice, corn, and barley. These authors also noted that good sources of most essential amino acids like methionine, lysine, leucine, isoleucine, phenylalanine, and so on, which are recommended for an ideal dietary protein, can be obtained from chicory seeds. Moreover, the seeds contain abundant demulcent oils, a good source of both saturated and unsaturated fatty acids, having the essential linoleic acid (18:2n-6) content of more than 76% of the total fatty acids profile which includes the monounsaturated oleic acid (18:1n-9), stearic acid (18:0), and palmitic acid (16:0). Relatively high levels of essential minerals such as potassium (K), calcium (Ca), magnesium (Mg), selenium (S), and zinc (Zn) are found in chicory seeds, when compared with those of alfalfa seeds. Elsewhere, identified phosphorus, potassium, calcium, magnesium, sodium (mg g^{-1}), iron (mg g^{-1}), copper (μg g^{-1}), zinc (μg g^{-1}), and manganese (μg g^{-1}) as the minerals present in chicory seeds. Some researchers found isolated cichotyboside, a sesquiterpene glycoside, from *Cichorium intybus* seeds, which was verified to exhibit a significant hepatoprotective activity in rats against carbon tetrachloride induced hepatic damage. Chicory seed can therefore be said to be a healthy alternative and/or complementary nutritional component in animal and human diets.
Various studies have reported that prebiotics stimulates the growth of host-beneficial gut bacteria, such as lactobacilli and bifido-bacteria for overall beneficial health. In addition, a prebiotic may stimulate the immune system, decrease the levels of pathogenic bacteria in the intestine, relieve constipation, decrease the risk of osteoporosis by increasing essential mineral absorption especially calcium, and reduce the risk of atherosclerosis by lowering the synthesis of triglycerides and fatty acids in the liver as well as lowering their serum levels. Volatile oils are found in all parts of the plant but are more concentrated in the roots which have been found to be effective at eliminating intestinal worms.

- ***Modern uses of it: -***

The leaves and flowers are usually used as vegetables in salads and the roots are used as a coffee substitute, livestock feedstuff, or pet food. Chicory extracts are sometimes added to alcoholic and nonalcoholic beverages to improve taste, while the inulin rich tuberous roots can be converted to alcohol. In some countries, parts of the chicory plant are used as ethnoveterinary remedy for bodily ailments and disorders and for prophylactic purposes in both humans and livestock. Since fresh chicory roots have a rather bitter taste, the roots are normally debittered by boiling, drying, baking or roasting, and soaking in water or citric acid solution and then chopped or milled before being used as coffee blends, feed, or a functional food ingredient.
To make better use of chicory to assist in the development of powerful, hepatoprotective feed additive, it is necessary to understand the mechanism of action of this novel herbal plant as a liver tonic; liver is a prime organ which performs many physiological functions in animals and poultry. The nutritional level of the birds is not only determined by what they eat but it depends on the function and processing of liver. Unluckily, it is very difficult to identify the early symptoms of liver imbalances and also longtime disorders due to the constant usage of antibiotics in broiler production as growth promoters. Trease and Evans mentioned that liver has complex chemistry and also plays an important function in the physiology of the bird by producing effective cures. There are some medicinal plants present similar to chicory having beneficial properties against hepatic disorders. Chicory is a good and very important protective source for hepatocytes. Clinical evaluation has also shown that it has ability to treat the liver problems. It increases feed consumption and improves immunity in broilers. It also improved liver function in birds & boilers; it was compared with silymarin medicine given to pets for liver disease & was found very effective in treating diseases & it improved the liver enzyme level to normal.

Inulin found in chicory is a source of soluble dietary fiber, a prototype prebiotic especially beneficial in mono-gastric nutrition and also used as a functional food additive.

- ***Contents/constituents of it: -***

All contents may not present in all types of it, because there are many varieties of it according to geographical regions & content may differ a lot as per cultivation, soil, seed, climate etc. Many constituents are mentioned above in clinical pharmacology column.

Many constituents are not explained because they are under research & very less information is available.

Chemical constituents of it (phytochemical analysis) showed that the different parts of the plant contained sesquiterpene lactones (especially lactucin, lactucopicrin, 8-desoxy lactucin, guaianolid glycosides, including chicoroisides B and C, sonchuside C), caffeic acid derivatives (chiroric acid, chlorogenic acid, isochlorogenic acid, dicaffeoyl tartaric acid), inulin, sugars, proteins, hydroxycoumarins, flavonoids, alkaloids, steroids, terpenoids, oils, volatile compounds, coumarins, vitamins and polyynes; alpha & beta-taraxasten, alpha-diol (cichoridiol) and 17-epi-methyl-6-hydroxyangolensate (intybusoloid), lupeol, friedelin, beta-sitosterol, stigmasterol, betulinic acid, betulin, betulinaldehyde, syringic acid, vanillic acid) 6,7-dihydroxycoumarin, and methyl-alpha-D-galactopyranoside were obtained from the methanolic extract of seeds of Cichorium intybus. A new guaianolide sesquiterpene glycoside, cichotyboside, which was characterized as 2 alpha, 6 beta, 7 beta, 15-tetrahydroxy-1, 4 (5)-diene-guaian-9alpha, 12-olide-7-O-beta-caffoyl-15-O-beta-D-glucoside, was isolated from the seeds of Cichorium intybus. A transformed root culture of Cichorium intybus L. was found to produce sesquiterpene lactones of guaiane and germacrane type. Lactucopicrin, 8-desoxylactucin and three sesquiterpene lactone glycosides (crepidiaside B, sonchuside A and ixerisoside D) were isolated from the roots. The yield of 8-desoxylactucin reached 0.03 g/l at the early stationary phase of the culture. Cichoriin-6'-p-hydroxyphenyl acetate, a new coumarin glucoside ester, was isolated from chicory leaves. The phytochemical screening of different parts (root, stem, leaves and seeds) of C. intybus showed the presence of tannins, saponins, flavonoids, terpenoids, cardiac glycosides and anthocyanins in each part. Tannins and saponins content of different parts of Cichorium intybus ranged from 0.66±0.02 to 1.51±0.03 and 0.16±0.08 to 0.77±0.27 g/100g dry weight. The total flavonoids (TF) and phenolic acids (TPA) content of different parts of Cichorium intybus ranged from 0.05±0.03 to 0.10±0.02 and 0.47±0.07 to 2.52±0.26 g/100g dry weight respectively.

- ***Inulin: -***

Inulins are a group of naturally occurring polysaccharides produced by many types of plants, industrially most often extracted from chicory. The inulins belong to a class of dietary fibers known as fructans. Inulin is used by some plants as a means of storing energy and is typically found in roots or rhizomes. Most plants that synthesize and store inulin do not store other forms of carbohydrate such as starch. Inulin is a natural, storage carbohydrate present in more than 36,000 species of plants, including wheat, onion, bananas, garlic, asparagus, Jerusalem artichoke, and chicory. For these plants, inulin is used as an energy reserve and for regulating cold resistance. Because it is soluble in water, it is osmotically active. Certain plants can change the osmotic potential of their cells by changing the degree of polymerization of inulin molecules by hydrolysis. By changing osmotic potential without changing the total amount of carbohydrate, plants can withstand cold and drought during winter periods. Chicory root is the main source of extraction for commercial production of inulin. The extraction process for inulin is similar to obtaining sugar from sugar beets. After harvest, the chicory roots are sliced and washed, then soaked in a solvent; the inulin is then isolated followed by purifying and drying. Inulin may also be synthesized from sucrose. Inulin and its analog sinistrin are used to help measure kidney function by determining the glomerular filtration rate (GFR), which is the volume of fluid filtered from the renal (kidney) glomerular capillaries into the Bowman's capsule per unit time. Inulin enhances the growth and activities of bacteria or inhibits growth or activities of certain pathogenic bacteria.

- ***Guaianolide: -***

Guaianolides are a large group of sesquiterpene lactones of chemotaxonomic as well as biological importance. The ability of the thapsigargins isolated from the genus *Thapsia* (Apiaceae) to inhibit an intracellular calcium pump and thereby inducing apoptosis has encouraged intensive research in order to develop a new drug, which at present is in clinical trial toward cancer diseases. Several other guaianolides have been investigated as chemotaxonomic markers. In particular, α-methylene guaianolides and guaianolides containing an α, β-unsaturated carbonyl moiety show biological activities.

- ***Crepidiaside B***

Crepidiaside B is a member of the class of compounds known as O-glycosyl compounds. O-glycosyl compounds are glycoside in which a sugar group is bonded through one carbon to another group via a O-glycosidic bond. Crepidiaside b is slightly soluble (in water) and a very weakly acidic compound (based on its pKa). Crepidiaside b can be found in chicory and endive, which makes crepidiaside b a potential biomarker for the consumption of these food products.

- ***Cichoriin: -***

Cichoriin belongs to the class of organic compounds known as coumarin glycosides. These are aromatic compounds containing a carbohydrate moiety glycosidically bound to a coumarin moiety. Cichoriin is an extremely weak basic (essentially neutral) compound (based on its pKa). Cichoriin is found, on average, in the highest concentration within chicories. Cichoriin has also been detected, but not quantified in, green vegetables. This could make cichoriin a potential biomarker for the consumption of these foods.

- ***Harmane: -***

Harmane (harman) is a heterocyclic amine found in a variety of foods including coffee, sauces, and cooked meat. It is also present in tobacco smoke; Harmane is a methylated derivative of β-carboline with the molecular formula $C_{12}H_{10}N_2$. Harmane is a potent reversible inhibitor of monoamine oxidase A (RIMA) and acts as a moderate affinity inverse agonist at the benzodiazepine site of the GABA-A receptor.

- ***Beta carboline: -***

β-Carboline (9*H*-pyrido[3,4-*b*]indole), also known as norharmane, is a nitrogen containing heterocycle. It is also the prototype of a class of indole alkaloid compounds known as β-carbolines. β-Carboline alkaloids are widespread in plants and animals, and frequently act as GABAA inverse agonists; β-Carboline belongs to the group of indole alkaloids and consist of pyridine ring that is fused to an indole skeleton.

- ***Cichoridiol: -***

Two new triterpenoids, 18alpha,19beta-20(30)-taraxasten-3beta,21alpha-diol (cichoridiol) (1) and 17-epi-methyl-6-hydroxyangolensate (intybusoloid) (2), were obtained from the methanolic extract of seeds of Cichorium intybus along with 11 known compounds, lupeol (3), friedelin (4), beta-sitosterol (5), stigmasterol (6), betulinic acid (7), betulin (8), betulinaldehyde (9), syringic acid (10), vanillic acid (11) 6,7-dihydroxycoumarin (12), and methyl-alpha-D-galactopyranoside (13). Compounds 1, 1a, and 11 showed a good alpha-glucosidase inhibitory activity.

- ***Aldehyde: -***

Aldehyde, any of a class of organic compounds, in which a carbon atom shares a double bond with an oxygen atom, a single bond with a hydrogen atom, and a single bond with another atom or group of atoms (designated R in general chemical formulas and structure diagrams). The double bond between carbon and oxygen is characteristic of all aldehydes and is known as the carbonyl group. Many aldehydes have pleasant odours, and in principle, they are derived from alcohols by dehydrogenation (removal of hydrogen), from which process came the name *aldehyde*.

- ***Vanillin: -***

Natural vanillin is an organic compound with the molecular formula $C_8H_8O_3$. It is a phenolic aldehyde. Its functional groups include aldehyde, hydroxyl, and ether. It is the primary component of the extract of the vanilla bean. It is present in chicory & contributes to the flavor and aroma of coffee; it is most prominent as the principal flavor and aroma compound in vanilla. Cured vanilla pods contain about 2% by dry weight vanillin; on cured pods of high quality, relatively pure vanillin may be visible as a white dust or "frost" on the exterior of the pod. It is also found in Leptotes bicolor, a species of orchid native to Paraguay and southern Brazil.

- ***Chicoric acid: -***

Chicoric acid (also known as cichoric acid) is a hydroxycinnamic acid, an organic compound of the phenylpropanoid class and occurs in a variety of plant species. It is a derivative of both caffeic acid and tartaric acid; Chicoric acid has first been isolated from *Cichorium intybus* (chicory) but also occurs in significant amounts in *Echinacea*; Chicoric acid has been shown to stimulate phagocytosis in both *in vitro* and *in vivo* studies, to inhibit the function of hyaluronidase (an enzyme that breaks down hyaluronic

acid in the human body), to protect collagen from damage due to free radicals, and to inhibit the function of HIV-1 integrase.

- ***Cichorin A: -***

A new benzo-isochromene, named cichorin A (1), together with three known compounds oleanolic acid, β-sitosterol, and β-sitosterol glucopyranoside, was isolated from Cichorium intybus. The structure of the new compound was elucidated by detailed spectroscopic analysis such as (1)H, (13)C NMR, COSY, HMQC, HMBC, and HR-EI-MS. Relative configuration of asymmetric centers of cichorin A (1) was determined by the analysis of the (1)H NMR coupling constants together with the NOESY experiment.

- ***Alpha-diol (cichoridiol) & intybusoloid: -***

Two new triterpenoids, 18alpha,19beta-20(30)-taraxasten-3beta,21alpha-diol (cichoridiol) (1) and 17-epi-methyl-6-hydroxyangolensate (intybusoloid), were obtained from the methanolic extract of seeds of Cichorium intybus along with 11 known compounds, lupeol, friedelin, beta-sitosterol, stigmasterol, betulinic acid, betulin, betulinaldehyde, syringic acid, vanillic acid 6,7-dihydroxycoumarin, and methyl-alpha-D-galactopyranoside. Compounds 1, 1a, and 11 showed a good alpha-glucosidase inhibitory activity.

- ***D-galactopyranoside: -***

Methyl-alpha-d-galactopyranoside from the methanolic extract of seeds of cichorium intybus, having good alpha glucosidase inhibitory activity.

- ***Benzothiazole: -***

Benzothiazole is among the usually occurring heterocyclic nuclei in many marine as well as natural plant products. Benzothiazole is a privileged bicyclic ring system with multiple applications. It is known to exhibit a wide range of biological properties including anticancer, antimicrobial, and antidiabetic, anticonvulsant, anti-inflammatory, antiviral, anti-tubercular activities. It is present in chicory.

- ***Lupeol: -***

Lupeol is a pentacyclic triterpenoid that is lupane in which the hydrogen at the 3beta position is substituted by a hydroxy group. It occurs in the skin of lupin seeds, as well as in the latex of fig trees and of rubber plants. It is also found in many edible fruits and vegetables. It has a role as an anti-inflammatory drug and a plant metabolite.

- ***Lactucin: -***

Lactucin is a bitter substance that forms a white crystalline solid and belongs to the group of sesquiterpene lactones. It is found in some varieties of lettuce and is an ingredient of lactucarium. It has been shown to have analgesic and sedative properties. It has also shown some antimalarial effects. It is also found in dandelion coffee.

- ***Lactucopicrin: -***

Lactucopicrin (Intybin) is a bitter substance that has a sedative and analgesic effect, acting on the central nervous system. It is a sesquiterpene lactone, and is a component of lactucarium, derived from the plant *Lactuca virosa* (wild lettuce), as well as being found in some related plants such as *Cichorium intybus*. It is also found in dandelion coffee.

- ***Tannin: -***

It is of astringent (dry & puckery feeling in mouth) taste, it is a polyphenol present in many plants, fruits, plant's wood, bark, leaves, skin, seeds etc. It is also called as Tannic acid; it is of 2 types hydrolysable & condensed. Hydrolysable is decomposable in water & reacts with water & form other substance. Condensed form is insoluble & precipitates, it is called as tanner's reds. But most of tannic acid is water soluble.

Main sources of tannin: -

It is present berries, apple, barley, nut, tea, legumes, grapes, pomegranate, quince, oak wood, lemons, squash etc.

Basic pharmacokinetics of tannin (based on human intake in natural food products): -

Its absorption, metabolism & excretion are yet not known & are under research. After ingestion its bioavailability is poor due to its large size, high affinity to bound to plasma protein & low lipid solubility. It gets hydrolyzed in glucose & release gallic acid & other compounds upon decomposition.

Basic clinical pharmacology of tannin: -

It is used internally & externally. Externally it cures & heals the condition when applied on cold sores, fever blisters, diaper rashes, bleeding gums, tonsillitis, skin rashes, white discharge, yellow discharge, minor burn etc. It is used as douche for virginal disorders like white or yellow discharge.
In food it is used as flavoring agent & naturally present in fruits etc, it relieves & cures chronic diarrhea, dysentery, hematuria (blood in urine), pain in joints, persist cold, cancers etc, it reduces high blood pressure, high lipids in blood. It is anti-aging, antioxidant, antibacterial, anti-enzymatic. It is used in medicated ointments for piles.
If used excessive it can give toxic effects on skin & internally may reduce absorption of vitamin, cause stomach irritation, nausea, vomiting, liver damage, kidney damage. It should not be used in pregnancy, breast feeding & constipation.

- ***Beta-sitosterol: -***

It is among phytosterols & a main dietary phytosterol found in plants. It is anticancer, anti-inflammatory, it improves urine flow, reduces symptoms of heart diseases, reduces cholesterol, boost immune system, reliefs bronchitis, migraine, asthma, fatigue, rheumatoid arthritis, improve hair quality, reliefs prostrate problems, improves erectile dysfunctioning, psoriasis, libido.

Main sources of beta-sitosterol: -

Canola oil, avocados, almond, soya bean oil, nuts, vegetable oil, dark chocolate, rice bran oil, wheat germ, corn oil, peanuts, grapes etc.

- ***Kaempferol: -***

It is a natural flavonol (a type of flavonoid) it is tetra-hydroxy-flavone.

Main sources of kaempferol: -

Fenugreek seeds, green tea, grapes, tomato, broccoli, spinach, raspberries, peaches, green beans, onion, potato etc.

Basic pharmacokinetics of kaempferol (based on human intake in natural food products): -

It is ingested as a glycoside, absorbed in small intestines usually by passive diffusion; it is metabolized in various parts of the body. In small intestine it is metabolized to glucuronide & sulfo-conjugate by intestinal enzymes & it is also metabolized by colon micro-flora (bacteria) which can hydrolyze the glycosides to aglycones or form simple phenolic compounds. It is mainly metabolized in liver to glucurono-conjugated & sulfo-conjugated form. It is mainly excreted in urine.

Basic clinical pharmacology of kaempferol: -

It is antioxidant, anti-inflammatory, antimicrobial, anticancer, cardio protective, neuro microbial, antidiabetes, estrogenic, analgesic, anxiolytic, antiallergic, antiviral etc.

- ***Stigmasterol: -***

It is among unsaturated phytosterol; it maintains the structure & physiology of cell membrane; it reduces LDL & cholesterol, reduces risk of heart diseases, it prevents atherosclerosis.

Main sources of stigmasterol: -

Soybean, calabar bean, rape seed, legumes, nuts, milk, seeds, grape seed oil etc.

- ***Saponin: -***

Saponins are glucosides with foaming characteristics. Saponins consist of a polycyclic aglycones attached to one or more sugar side chains. The aglycone part, which is also called sapogenin, is either steroid (C27) or a triterpene (C30). The foaming ability of saponins is caused by the combination of a hydrophobic (fat-soluble) sapogenin and a hydrophilic (water-soluble) sugar part. Saponins have a bitter taste. Some saponins are toxic and are known as sapotoxin.

Basic clinical pharmacology of saponin: -

It reduces cholesterol, LDL, increases testosterone, libido & muscle mass; it maintain balance between cellular proliferation & cell death the disturbances in the balance cause severe diseases like cancer etc; it is anti-bacterial, antioxidant, inhibit tumour growth.

- ***Cardiac glycoside: -***

Cardiac glycosides are a class of organic compounds that increase the output force of the heart and increase its rate of contractions by acting on the cellular sodium-potassium ATPase pump. Their beneficial medical uses are as treatments for congestive heart failure and cardiac arrhythmias.

- ***Linoleic acid: -***

It is a carboxylic acid, it make up 3% to 15% of extra virgin olive oil, It is polyunsaturated with omega 3 & 6 fatty acids; its short hand notation is 18:2, it is an essential fatty acid that must be consumed for health.

Main sources of linoleic acid: -

It is present in olive oil, evening primrose oil, sunflower oil, walnut oil, hemp oil, grape seed oil, safflower oil, egg yolk, butter & etc.

Basic pharmacokinetics of linoleic acid (based on human intake in natural food products): -

It is first hydrolyzed from dietary fats & pancreatic enzymes & then with the help of bile it is absorbed in small intestine; metabolism & excretion are under research.

It gets converted into gamma linoleic acid (GLA) in the body, GLA is converted in the body into dihomo GLA (20 carbon chain) & it is converted into Arachidonic acid which is converted into Docosatetraenoic (long chain fatty acid with 22 carbons) acid.

Basic clinical pharmacology of linoleic acid: -

It acts on prostaglandin system of the body thus is anti-inflammatory, blood thinner, vasodilator (expand the blood vessel) it is very helpful in treatment of rheumatoid arthritis, breast lumps, fibro-adenoma (nodes in breast), cancers, reduces cholesterol, it prevents heart disease, diabetes, skin ulcers, irritable bowel syndrome etc.

- ***Palmitic acid: -***

It makes up 7% to 13% of extra virgin olive oil; it is a common saturated fatty acid; it is the first fatty acid produced during lipogenesis (fatty acid synthesis) & from which longer fatty acids can be produced.

Main sources of palmitic acid: -

It is present in olive oil, flaxseed oil, soyabean oil, sunflower oil, palm oil, cocoa butter, meat, milk & etc.

Basic pharmacokinetics of palmitic acid (based on human intake in natural food products): -

Its absorption, metabolism & excretion are under research.

Basic clinical pharmacology of palmitic acid: -

It softens the skin & keeps it moist thus good for psoriasis & eczema. It coats the skin, it is powerful anti-oxidant; it maintains the health of hair & skin from aging, cleans them from dirt, sweat, excessive sebum (main cause of acne and boil on face & other parts of the body).

- ***Stearic acid: -***

It makes up 0.5% to 5 % of extra virgin olive oil; it is saturated fatty acid. It is also known as octadecanoic acid.

Main sources of stearic acid: -

It is mainly present in olive oil, also present in butter, whole milk, yeast bread, egg & etc.

Basic pharmacokinetics of stearic acid (based on human intake in natural food products): -

Its absorption, metabolism & excretion are under research.

Basic clinical pharmacology of stearic acid: -

It cleans the skin & removes dirt, sweat & excessive sebum from skin & hair. The colour of olive oil is due to pigments of stearic acid like chlorophyll, pheophytin & carotenoid that's why extra virgin olive oil has colour of its own which refined & pomace do not have.

- ***Syringic acid: -***

It is a naturally occurring Trihydroxybenzoic acid or dimethoxybenzoic acid; it has a role as a plant metabolite, it is a member of benzoic acid & phenols; it can be derive from gallic acid; it is anti-diabetic, it is present in wheat, maize, oats, rice, dates, apple, grapes, olive oil, rape, seed oil ,thyme, marjoram, vinegar, walnut etc.

- ***Dicaffeoylquinic acid: -***

It is a polyphenol compound found in plants. It belongs to the class of organic compound known as quinic acid & derivatives; many times it may be called as cynarine (hydroxycinnamic acid).

Main sources of dicaffeoylquinic acid: -

It is present in quince, coffee.

- ***Coumaric acid: -***

It is hydroxycinnamic acid belongs to non-flavonoids phenol; it is present in following with caffeic acid kiwi, apple, coffee, grapes, blueberries, cereal grains etc. It is an antioxidant, ant-inflammatory, increases complexion. Every less is known about it yet.

- ***Coumarin: -***

It is oxygen containing heterocyclic compound; it is among polyphenolic compound present in many plants; it is colourless, crystalline phytochemical; it belongs to benzopyrones family; it is found in many essential oils.

Main sources of coumarin: -

Fenugreek, cassia cinnamon, vanilla grass, cucumber etc.

Basic pharmacokinetics of coumarin (based on human intake in natural food products): -

It is absorbed rapidly in small intestines & metabolized in liver, very less is known about its digestion. It is stored in liver, kidney, brain, heart, lungs, muscles; it crosses the blood brain barrier; it is excreted in urine mainly & little in stool.

Basic clinical pharmacology of coumarin: -

It is anti-inflammatory, anti tumour, antibacterial, antioxidant, anticoagulant etc.

- ***Caffeic acid: -***

It is 3-4 dihydroxycinnamic acid; it is a type of polyphenol; it is antioxidant, anticancer, antiviral, anti-inflammatory, boosts athlete performance, reduces blood glucose in diabetes, and reduces aging. It is present coffee, turmeric, thyme, cabbage, apple, mushroom, olive oil etc. Every less is known about it yet.

- ***Chlorogenic acid: -***

It is the ester of caffeic acid & quinic acid; it is among polyphenol & present mainly in coffee; it has similar action & effect to caffeine, but less potent; it reduces the absorption of carbohydrate, reduces blood glucose, blood pressure & is anti-obesity, improves mood.

It is mainly present in apples, pear, carrot, tomato, sweet potato, coffee, thyme, tea, marjoram etc.

- ***Vanillic acid: -***

It is a dihydroxybenzoic acid used as a flavouring agent; it is mainly present in root of angelica sinensis (herb from china), acai oil, argan oil, vinegar etc. It is antioxidant, anti-inflammatory, anti-pain, neuro-protective.

- ***Betulinic acid: -***

Betulinic acid is a naturally occurring pentacyclic triterpenoid which has antiretroviral, antimalarial, and anti-inflammatory properties, as well as a more recently discovered potential as an anticancer agent, by inhibition of topoisomerase.

- ***Betulin: -***

Betulin is an abundant, naturally occurring triterpene. It is commonly isolated from the bark of few trees. It an ingredient found in abundance in birch bark appears to have an array of metabolic benefits. In mice, the compound known as betulin lowered cholesterol, helped prevent diet-induced obesity, and improved insulin sensitivity.

- ***Pyrazine: -***

It is a heterocyclic aromatic organic compound; it is water soluble; it is used as flavouring agent & fragrance agent; it is present in black seed oil, fenugreek seed oil. It is anti tumour, antibiotic, diuretic.

It is excreted as glucuronates or bound to glutathione via kidneys after hydroxylation. It absorption is not known.

- ***Anthocyanin: -***

It is a type of flavonoid & is the pigments that give red, purple & blue plants their rich colouring.

Main sources of anthocyanin: -

Black soybean, pomegranate, black berries, cherries, grape, plums etc.

Basic pharmacokinetics of anthocyanin: -

Its absorption, metabolism & excretion are not known yet and are under research.

Basic clinical pharmacology of anthocyanin: -

It is a strong antioxidant, anticancer, anti-inflammatory, removes free radicals from the body, prevents heart diseases, blood pressure, infections, urinary infections, cough & cold.

- ***Germacrene d: -***

It is a volatile sesquiterpene & amongst essential oils; it is found in many species & is of two prominent molecules Germacrene A & D; D is present mainly in lamium purpureum, clausena auisata, basil, clary sage etc.

- ***Guaiane: -***

Guaiane-type sesquiterpenes are present in approximately 70 genera of 30 plant families (e.g., Asteraceae, Lamiaceae, Thymelaeaceae, and Zingiberaceae); they can be classified into 12,6-guaianolides, 12,8-guaianolides, pseudoguaianolides, tricycle guaiane-type sesquiterpenes, dimers or trimers containing guaiane-type sesquiterpenes mother nuclei, variant guaiane-type sesquiterpenes, and other guaiane-type sesquiterpenes. Among them, 12,8-guaianolides exerted the broadest biological activity.

- ***Potassium: -***

It is a mineral with symbol K & atomic number 19, it is an essential mineral which body cannot prepare; it is necessary for heart, kidney & other organs to function, its low level in body is called as hypokalemia & high level is called as hyperkalemia; it is mostly present inside the cells (intracellular); normal blood range is 3.5 to 5.0 milli equivalents per/liter (mEq/L).

Main sources of potassium: -

Potassium is naturally present in banana, orange, dates, raisin, broccoli, milk, chicken, sweet potato, pumpkin, spinach, watermelon, coconut water, white & black beans, potato, dried apricot, beetroot, pomegranate, almond, quince, cucumber etc.

Basic pharmacokinetics of potassium (bases on human intake in natural food products): -

It is absorbed in small intestines by passive diffusion; it is stored mostly inside the cell, little in liver, bones & red blood cells. 80 to 90% potassium is excreted in urine & 5 to 20% is excreted in stools, sweat.

Basic clinical pharmacology of potassium: -

It is a mineral belongs to electrolytes of the body; it conducts electrical impulses throughout the body & assists blood pressure, normal water balance, muscle contraction, nerves impulse, digestion, heart rhythm, maintain pH balance. It is not produced in our body so we need to consume it through eating; Kidneys maintain normal level of it in the body by excreting excessive amount of it in urine or reabsorb it if the amount is less in the body so that the body may reuse it. Its deficiency may cause weakness, low blood pressure, constipation, nausea, vomiting etc.

Its normal amount in body keeps blood pressure normal; water balance in body normal; prevents heart disease, stroke, osteoporosis, kidney stone etc.

- ***Sodium: -***

Here we are learning natural sodium, its symbol is Na & atomic no. 11; it is not produced in the body we need to take it in food sources; it is an important & essential mineral on which our body functions; it regulates blood pressure, blood volume etc.

Main sources of sodium: -

Excessive intake of sodium should be avoided; cucumber has very less amount of sodium; vegetables & fruits have less sodium in them which is good for the body. It is present in beans, meat, fish, chicken, chilli, bread, rolls, milk, celery, beetroot etc.

Basic pharmacokinetic of sodium (based on human intake in natural food products): -

It is absorbed in ileum by active sodium transport because it is impermeable & in jejunum absorption takes place via mediated active transport & depends on levels of water, bicarbonate, glucose, amino acids etc; its absorption plays an important role in the absorption of chloride, amino acids, glucose & water; similar mechanism are involved in the reabsorption of it in kidneys when its level in the body falls. It is excreted mainly in urine, little in sweat & stools. It is stores in bones & dissolved in various body fluids.

Basic clinical pharmacology of sodium: -

It is amongst the essential electrolyte within the body, it remains in extracellular fluid (outside the cell) mainly, it carries electrical charges within the body, kidney maintain its normal level in the body, normal level is 135-145 milli-equivalent per liter (mEq/L), it is not produce in the body, it acts on muscles contraction, nerve cells, regulates blood pressure, blood volume; it takes part in every function of the body mostly, its low level in body is called as hyponatremia, it is found more in older aged, kidney disease, heart disease, hospitalized patient, this condition may cause brain edema, low blood pressure, fatigue, tiredness etc; its high level in the body is called as hypernatremia may cause increase in blood pressure, thirst, confusion, muscle twitching or spasm, seizures, weakness, nausea, loss of appetite, swelling in body etc.

Basic clinical pharmacology of flavonols: -

All types of flavonols are antioxidant, anti-inflammatory, anticancer, reduce oxidative stress, maintains heart health, helpful in asthma, stroke, helps in regulating cellular signaling etc.

- ***Calcium: -***

It is natural essential mineral for the body, it is among the electrolytes of the body; its symbol is Ca & atomic no. 20.

Main sources of calcium: -

It is present in watermelon, quince, milk, banana, cheese, green leafy vegetables, soya beans, nuts, fish, meat, egg, bread, flour, yogurt, almonds, kale, soybean, spinach, cucumber etc.

Basic pharmacokinetics of calcium (based on human intake in natural food products): -

Calcium is absorbed in duodenum & upper jejunum (when calcium intake is low) by transcellular active transport process, this depends on action of calcitriol & intestinal vitamin D receptors & when calcium intake is high, absorbed

by paracellular passive process throughout the length of small intestine by 3 major steps, entry across the brush border, intracellular diffusion via calcium-binding protein & extrusion; Vitamin D is necessary for absorption of calcium, also vitamin C, E, k, magnesium & exercise increases the absorption of calcium. Also the level of calcium is regulated by calcitonin released by thyroid gland it reduces calcium level in blood when it is excessive & increases the excretion of calcium via kidneys; Parathyroid hormones (PTH) released by parathyroid gland increases the blood level of calcium when body need it or calcium is less in blood & promotes reabsorption of it in kidneys (calcitonin & PTH both have opposite function). Intestines can absorb 500 to 600 mg of calcium at a time; it is mostly stored in bone tissues & teeth & excreted in stool & sweat & little in urine depended upon the level of it in blood. Also estrogen act on transport of blood calcium in bones thus women mostly suffer from osteoporosis after menopause.

Basic clinical pharmacology of calcium: -

Calcium acts on bone health, communication between brain & other parts of the body, muscles contraction, blood clotting; it is a co-factor for many enzymes, it relaxes the smooth muscles & blood vessels; it maintains heart rhythm, muscles function; it is more needed in childhood & deficiency of it in childhood may cause convulsions (seizure); Excessive level of it in blood is called as hypercalcemia & may lead to kidney stone formation, heart attack, stroke, loss of appetite, excessive urination, memory loss etc; its low level in blood is called as hypocalcemia & may lead to cramps in the body, weak bones, weak teeth, numbness, tingling etc.

Contraindication: -

Sarcoidosis, excessive level of calcium in blood, very severe constipation, kidney stones, increased activity of parathyroid gland etc. Hypersensitivity of calcium, severe cardiac diseases, hypercalcemia, hypercalciuria, severe kidney stones etc.

- ***Iron: -***

It is an essential mineral for our body; its symbol is Fe & atomic no. 26; it is an important component of heamoglobin (heamoglobin binds oxygen in lungs & supply it to whole body, it is oxygen carrier).

Main sources of iron: -

It is present in watermelon, quince, meat, dates, spinach, egg, nuts, dark leafy green vegetables, broccoli, pumpkin seeds, chicken, legumes, fish, banana, cabbage, kidney, almonds, cucumber etc.

Meat is the best source of iron, it provides Fe+2 directly which can be transported from intestine to blood steam through Fe+2 transporter ferroportin (this binds with transferring & delivered into tissues).

Basic pharmacokinetics of iron (based on human intake in natural food products): -

The absorption of iron is not known fully; about only 10% of iron taken in food is absorbed; it is absorbed in duodenum & upper jejunum mainly & at the end part of ileum; low pH is needed for its absorption, after absorption it get bind to transferring (each transferring can carry 2 atoms of iron); ceruloplasmin (protein) also helps in binding of iron; Hepcidin a hormone produced by liver is released when iron stores are full & inhibits iron transport & binding, thus reduces the absorption of iron; vitamin C & copper enhances iron absorption.

Storage of iron: -

Iron is stored in liver (in hepatocytes & kupffer's cells) kupffer's cells play an important role in recycling body iron, they ingest aged RBC liberate iron for it & reuse by breaking down heamoglobin. Little iron is stored in liver, heart, & kidneys in form of ferritin also little in bone marrow, spleen.

Excretion of iron: -

The body does not possess a physiological mechanism for regularly eliminating iron from the body because most of it is recycled by liver cells; iron is lost within cells, from skin & interior surface of the body (intestines, urine, breathe).

Basic clinical pharmacology of iron: -

It is an important component of Haemoglobin (heamoglobin bind oxygen in lungs & supply it to whole body); iron is beneficial for nails, hair, skin etc; it acts on blood production, its deficiency causes Anaemia (low haemoglobin level in blood) (this causes reduced in oxygen carrying capacity & supply of it); most of the iron is present in haemoglobin, it consist of one heme (iron), one protein chain (globin) this allows it to bind & load oxygen from the lungs & supply it to whole body.

Unbounded or free iron is highly destructive & dangerous it can trigger free radical activity which can cause cell death & destroy DNA.

- ***Copper: -***

It is an essential micronutrient mineral; its symbol is Cu & atomic no. 29; there are lot of health benefits of it; it is needed in little amount in the body.

Main sources of copper: -

It is present in watermelon, quince, spirulina (water-plant), nuts, seeds, lobster, leafy green vegetables, guava, grapes, green olive, kiwi, mango, pineapple, pomegranate, egg etc.

Basic pharmacokinetics of copper (based on human intake in natural food products): -

It is absorbed 30 to 50%; it is absorbed easily than other minerals, its absorption depends on the copper present in the body, when the intake of it is less, absorption is increased & when intake is more absorption is less, it is mainly absorbed in small intestines & little in stomach via carrier-mediated process; its absorption is influenced by amino acids, vitamin C & other dietary factors. After absorption it is bound primarily to albumin, peptide & amino acids & transported to liver. Copper is secreted into plasma as a complex with ceruloplasmin. It is mainly stored in liver little in brain, heart & kidneys; it is excreted mainly in bile & little in urine.

Basic clinical pharmacology of copper: -

Together with iron it enables the body to form RBC; it helps to maintain health of bones, blood vessels, nerves & immune system; it also acts on iron absorption, protein metabolism, growth of body, it acts also on development of brain, heart & other organ; it is needed by the body for making ATP, collagen. Excessive of it may cause Wilson's disease.

Deficiency of copper: -

It is very rare; but may cause cardiovascular disease, genetic defects, inflammation of optic nerve etc.

- ***Selenium: -***

It is an essential trace mineral, it is micro nutrient helpful to our body; its symbol is Se & atomic no. 34.

Main sources of selenium: -

It is present in watermelon, fish, nuts, beef, chicken, mushroom, egg, grains, garlic, grapes etc.

Basic pharmacokinetics of selenium (based on human intake in natural food products): -

It is mainly absorbed in duodenum & proximal jejunum by active transport process; Dietary selenium is in 2 forms organic (selenoimethionine) it is 90% absorbed & inorganic (selenite) it is 50% absorbed; after absorption it is send in liver via portal veins, liver turns it into selenite & then is bound with selenoproteins & send into blood stream, gets in RBC, muscles, tissues etc; it is not distributed evenly in the body, liver has more of it; Vitamin E & other vitamins increases its absorption & both work as an anti-oxidant. Natural selenium remains in the body for less than 24 hours; it is stored in amino acid in skeletal muscles, little in liver, kidneys & pancreas; it is primarily excreted in urine, stool & expired in air via lungs very little in sweat & semen.

Basic clinical pharmacology of selenium: -

It is important for many body functions, immune system, fertility (both male & female); it contributes in thyroid hormone metabolism, DNA synthesis; it protects the body from oxidative damages & infection, it is found in tissues, skeletal muscles; it helps testies & seminal vesicles in their function; it reduces the risk of miscarriages, liver disease, cancer, asthma, cardio vascular disease; deficiency of it causes pain in muscles & joints, weaken the hair, nails, white spots on nails are found etc.

- ***Magnesium: -***

It is an important essential mineral; its symbol is Mg & atomic no. 12; it is a co-factor for more than 300 enzymes that regulates functions in the body. Its normal range in blood is 0.75 to 0.95 millimoles (mmol)/L.

Main sources of magnesium: -

It is present in watermelon, quince, spinach, meat, egg, nuts, dark leafy green vegetables, broccoli, pumpkin seeds, dates, chicken, fish, legumes, cucumber etc.

Basic pharmacokinetics of magnesium (based on human intake in natural food products): -

It is absorbed about 20 to 50% only; it is absorbed about 40% in distal intestine when the level of it is low via passive paracellular transport & about 5% in descending colon when the level of it is high via active transcellular transport. Vitamin D increases its absorption & also acts on its excretion in urine. It is excreted in urine & stool; it is stored in bones.

Basic clinical pharmacology of magnesium: -

It is a co-factor for more than 300 enzymes that regulates functions in the body. It act on protein synthesis, muscles & nerve function, blood glucose, control blood pressure, it is required for energy production, bone development, synthesis of DNA & RNA. It also plays a role in active transport of calcium & potassium ions, muscles contraction, normal heart rhythm etc.

- ***Phosphorus: -***

It is an essential mineral; its symbol is P & atomic no. 15, it is needed for many parts & functions of the body.

Main sources of phosphorus: -

It is present in watermelon, quince, meat, nuts, beans, fish, chicken, dairy products, soy, grains, lentils, cucumber etc.

Basic pharmacokinetics of phosphorus (based on human intake in natural food products): -

It is absorbed 70-85%, it is absorbed 30% in duodenum, 20% in jejunum, 35% in ileum; it is absorbed in inorganic phosphate form by 2 separate process first when the phosphorus intake is high mainly after meals by paracellular sodium independent passive diffusion pathway & second is transcellular sodium dependant carrier-mediated pathway this falls under the control of vitamin D & etc. When calcium level is too high in the body phosphorus is less absorbed, optimum calcium : phosphorus ratio is helpful in its absorption (excess of anyone decreases the absorption of both). It is stored in bones 85% & rest in tissues; it is excreted 80% in urine & rest in stools (excretion of it is a regulatory action of parathyroid hormone (PTH), vitamin D, and fibroblast).

Basic clinical pharmacology of phosphorus: -

It is present in nature combined with oxygen as phosphate. It acts on growth of teeth, bones, repairs of cells & tissues. It plays an important role in metabolism of carbohydrate, fats, protein & ATP. It works with B-complex vitamins & helps kidney function, muscles contraction, normal heart beats, nerve impulse etc.

- ***Zinc: -***

It is a trace mineral; symbol is Zn & atomic no. 30; it is necessary for human body as it plays vital role in health.

Main sources of zinc: -

It is present in watermelon, quince, meat, fish, legumes, beans, egg, dairy products, seeds, nuts, whole grains, cucumber etc.

Basic pharmacokinetics of zinc (based on human intake in natural food products): -

It is absorbed 20 to 40%, its absorption depends on its concentration & is absorbed in whole intestines (jejunum has high rate of its absorption) via carrier-mediated mechanism, it is released from food as free ions during digestion. Zinc from animal sources is easily absorbed comparing to plants sources. It is present in bile & pancreatic juices which is released in duodenum & is reused by the body this is called as endogenous zinc & zinc present is food sources is called as exogenous zinc. Its absorption depends on 2 proteins- Albumin & metallophinonein. Albumin enables zinc to be transported from plasma into enterocytes. It is stored in muscles, bones mainly & little in prostate, liver, kidneys, skin, brain, lungs, heart & pancreas. It is excreted in stools 80% & rest in urine & sweat. Metallophinonein binds to zinc to make it unavailable & excrete it in stools when zinc is excess in the body, & production of metallophinonein is reduced when zinc is less in the body to make zinc available for the body.

Basic clinical pharmacology of zinc: -

It is necessary for immune system, prevents skin diseases, heal skin diseases, helps stimulate activity of at least 100 different enzymes in the body; it is required in little amount in the body, but children, pregnant & old aged need it more. It promotes growth in children, synthesize DNA & acts on wound healing, it is best in treating initial diarrhea & cold cough. It improves learning, memory, fertility etc. It heals acne, attention deficit hyper activity disorder (ADHD), osteoporosis, pneumonia etc.

- ***Manganese: -***

It is an essential mineral & micro nutrient, needed by the body for proper health. Its symbol is Mn & atomic no. 25.

Main sources of manganese: -

It is present in watermelon, nuts, beans, legumes, brown rice, leafy green vegetables, pineapple, beetroot etc.

Basic pharmacokinetics of manganese (based on human intake in natural food products): -

It is absorbed 40%, it is absorbed more in women than men; if intake of it is more, than absorption is less & if intake is less, absorption is more; its absorption takes place in small intestines, after absorption it is bounded to blood protein transferring & transmanganin & transport via blood stream to tissues; it is absorbed by inhalation & dermal (skin) also; it crosses brain blood barrier. It is stored in bones, liver, kidney, pancreas; it is excreted mainly in bile & stools, little in urine & sweating; unused manganese is transported to liver for excretion & excreted via bile mainly.

Basic clinical pharmacology of manganese: -

It is needed for proper health of skin, bones, cartilage etc; it helps in glucose tolerance, regulates blood sugar, reduces inflammation, reduces premenstrual cramps, it also aids in formation of connective tissues, bones, sex hormones, blood clotting, metabolism of carbohydrates & fats; it facilitates calcium absorption.

- ***Vitamin A: -***

It is a fat soluble vitamin; it is group of unsaturated organic compound that includes retinol, retinal, retinoic acid & several provitamin A carotenoid. There are 2 types of vitamin A, 1) Vitamin A: - found in meat, poultry, fish & dairy products; 2) Provitamin A: - found in fruits, vegetables, plants; beta carotene is common type of provitamin A; it is an

antioxidant, reduces wrinkles & repairs the skin damages; it is available in the market as tretinoin in tablets & creams to heal acne.

Main sources of vitamin A: -

It is present in watermelon, fish oil, carrot, green leafy vegetables, citrus fruit, sweet potato, spinach, kale, quince, pumpkin, grapes etc.

Basic pharmacokinetic of vitamin A (based on human intake in natural food products): -

It is absorbed in jejunum mainly, little through skin; metabolism is in liver & excreted in urine & stools, it is conjugated with glucuronic acid & then changed into retinal & retinoic acid; retinoic acid is excreted in stool, mainly. It is stored primarily as palmitate in Kupffer's cells of liver, normal adult liver stores sufficient amount of it which is enough for 2 years for the body, little is stored in kidneys, lungs, adrenal glands, fats, retina; it is excreted in urine & stools.

Clinical pharmacology of vitamin A: -

it is needed by the body for vision and maintains eye health specially retina; it prevents night blindness; it helps in normal reproduction of cells thus prevents cancer; it is required for proper growth & development of embryo throughout the pregnancy period, it is good for skin, supports immune function; helps the heart, kidneys & lungs to work properly.

- ***Vitamin K: -***

It is a fat soluble vitamin; it is essential for normal blood clotting; it occurs naturally in two forms, vitamin K1 (phylloquinone) which is widely distributed in plants; it is present in it; Leafy vegetables are good sources of K1; vitamin K2 (menaquinones) is synthesized in alimentary tract by bacteria (Escherichia coli & other bacteria).

Main sources of vitamin K1: -

It is present in olive oil & also present in green leafy vegetables (spinach, kale etc) cauliflower, cabbage, broccoli, sprout, fish, liver, meat, egg, cereals, pumpkin, grapes etc.

Basic pharmacokinetics of vitamin k (based on human intake in natural food products): -

It is absorbed in small intestine, bile is required for it absorption & stored in fatty tissues & liver; it is excreted 40% to 50% in stools & 30% to 40% in urine.

Basic clinical pharmacology of vitamin K: -

It acts on synthesis of certain proteins that are prerequisites (necessary) of blood coagulation (means act on stop bleeding) & body also needs it to control the binding of calcium in bones & other tissues. Deficiency of it makes bones weaker, calcification of arteries & other tissues thus take care of bones, joints & heart; it reduces tumour growth & is helpful in cancers.

- ***Vitamin E: -***

It is fat soluble vitamin; it is a group of eight fat soluble compounds that includes four tocopherols & four tocotrienols.

Main sources of vitamin E: -

It is present in olive oil, almonds, cereals, wheat germ, sunflower oil, corn oil, soybean oil, peanuts, green leafy vegetables, pumpkin, grapes etc.

Basic pharmacokinetics of vitamin E (based on human intake in natural food products): -

It is absorbed in small intestines & metabolized in liver & distributed through lymphatic system & stored in fat droplets of adipose tissue cells; it is mainly excreted in stool, little in urine & through skin.

Basic clinical pharmacology of vitamin E: -

It prevents coronary heart disease, supports immune system, prevent inflammation, promotes eye health, lowers the risk of cancer; It is a powerful anti-oxidant thus reduces UV damage of skin, nourishes & protects the skin when applied on face; also promotes hair growth.

- ***Vitamin C: -***

It is also called as Ascorbic acid; it is an essential water soluble vitamin, very much needed by the body for many functions & absorption etc.

Main sources of vitamin C: -

It is present in watermelon, citrus fruit, broccoli, cauliflower, sprouts, capsicums, papaya, strawberries, spinach, green & red chillies, cabbage, leafy vegetables, tomato, cereals, quince, cucumber etc.

Basic pharmacokinetic of vitamin C (based on human intake in natural food products): -

It does not need to undergo digestion, 80 to 90% of it eaten is absorbed by intestine cell border by active transport & passive diffusion & through ion channels it enters the plasma via capillaries. It is very little stored in adrenal

glands, pituitary gland, brain, eyes, ovaries, testes, liver, spleen, heart, kidneys, lungs, pancreas & muscles. All together body can store 5 grams of it & we need 200mg/day in order to maintain its normal level & uses, but old, disease person, smokers & alcoholic need more daily value. It is excreted in urine in the form of dehydroascorbic acid changed by liver & kidneys both, but unused vitamin C is excreted intact.

Basic clinical pharmacology of vitamin C: -

It prevent cough & cold, repairs tissue, acts as an enzyme for curtain neurotransmitter, important for immune function, it is a powerful antioxidant (donates electron to various enzymatic & non-enzymatic reactions); body prepares collagen with the help of vitamin c; it is also helpful in Alzheimer's, dementia, acts on iron absorption, it protects the body from oxidative damages, reduces stiffness of arteries, reduces tendency of platelets to clump each other, improves nitric oxide activity (dilatation of blood vessels) thus prevents high blood pressure & heart disease, also prevent eye disease, reduces risk of cataract, prevents the lining of lungs & prevents lung disease, it is a natural antihistamine (anti-allergy), eliminates toxins from the body. Deficiency of it causes Scurvy disease (brown spots on skin occurs, swelling of gums, bleeding from all mucous membrane, spots are more on thighs & legs, the person looks pale, feel depressed, cannot move, loss of teeth, suppurative wounds occur.

- ***Vitamin B1 (Thiamin): -***

It is called as Thiamin also; it is a water soluble vitamin, it belongs to B-complex family, it is an essential micro nutrient which cannot be made by our body.

Main sources of vitamin B1: -

It is present in watermelon, spinach, legumes, banana, quince, wheat germ, liver, egg, meat, dairy products, nuts, peas, fruits, vegetables, cereals, rice, breads, oats, cucumber etc.

Basic pharmacokinetic of vitamin B1 (based on human intake in natural food products): -

Intestinal phosphatases hydrolyze thiamin to make it free & absorbed in duodenum, jejunum mainly through active transport in nutritional doses & passive diffusion in pharmacological doses, very little is known about its absorption; it is metabolized in liver; it is excreted in urine & stored little in liver, heart, kidney, brain, muscles.

Clinical pharmacology of vitamin B1: -

It is needed for metabolism of glucose, amino acids (proteins), lipids (fats) etc; every cell of the body require it to form ATP (adenosine triphosphate) as a fuel for energy, also it enables the body to use carbohydrates as sources of energy; also nerve cells, heart cells, muscles cell require it to function normally; its deficiency causes beri-beri heart disease, weight loss, confusion, malaise, optic neuropathy, irritability, memory loss, delirium, muscles weakness, loss of appetite, tingling sensation in arms & legs, blurry vision, nausea, vomiting, reduce refluxes, shortness of breath etc; it is helpful to immune system; excessive intake of carbohydrates, protein, glucose (specially in body builders, athletes etc) increases the need of vitamin B1.

- ***Vitamin B2: -***

It is also called as Riboflavin, it is a water soluble vitamin, it is an essential micro nutrient, it helps many systems of the body; it is not synthesized in human body.

Main sources of vitamin B2: -

It is present in watermelon, liver, milk, dairy products, nuts, egg, fish, leafy vegetables, almonds, mushroom, lean meat and quince, cucumber.

Basic pharmacokinetic of vitamin B2 (based on human intake in natural food products): -

It is phosphorylated in the intestinal mucosa during absorption; mainly absorbed in upper gastrointestinal tract; the body absorbs little from a single dose beyond of 27mg; when excessive amount is eaten it is not absorbed; very little is known about its absorption. The conversion of it into its coenzymes takes place mainly in cells of small intestines, heart, liver, kidneys & throughout the body in many cells; it is excreted in urine & stored little in liver, heart, kidneys & in tissues of the body.

Basic clinical pharmacology of vitamin B2: -

It is needed by the body to keep skin, eyes, nerves, red blood cells healthy, it also helps adrenal gland, nerve cells, heart, brain to function; it also act in metabolism of food, amino acids (protein), fats, helps to convert carbohydrate into energy (Adenosine triphosphate formation- the energy body runs on). It plays an important role in functioning of mitochondria.

Its deficiency is called as Ariboflavinosis & causes weakness, throat swelling, soreness of mouth & tongue, cracks on skin, dermatitis, anemia, weak vision, itching & irritation in eyes, migraine.

- ***Vitamin B3: -***

It is called as Niacin or Nicotinic acid; it is in 2 forms niacin & nicotinamide acid; it is water soluble vitamin; it is an essential micro nutrient; it plays a role in over 200 enzymatic reactions in the body; It is produced in the body in small amount from tryptophan which is found in protein containing food & sufficient amount of magnesium, vitamin B6 & B2 (are needed to produce it).

Main sources of vitamin B3: -

It is present in watermelon, green peas, peanuts, mushroom, avocados, meat, egg, fish, milk, cereal, green vegetables, liver, chicken, coffee, potato, corn, pumpkin, tomato, almonds, spinach, enriched bread, carrots, quince, cucumber etc.

Basic pharmacokinetic of vitamin B3 (based on human intake in natural food products): -

If eaten in natural form it is absorbed in stomach & small intestines by the process of sodium-dependent carrier-mediated diffusion in 5 to 20 minutes; if taken in therapeutic doses get absorbed by passive diffusion in small intestines. Its uptake in brain requires energy, in kidneys & red blood cells requires a carrier. It is metabolized in liver in 2 ways either is conjugated with glycine or niacin is form into nicotinamide; it is stored little in liver unbounded to enzymes. It is excreted in urine.

Basic clinical pharmacology of vitamin B3: -

It regulates lipid level in the body; it acts on carbohydrate to form energy sources for the body, it ease arthritis, boost brain function, every part of body needs it to function properly, it helps convert food into energy by aiding enzymes & cellular metabolism, it acts as an antioxidant. It prevents heart disease. Deficiency of it causes pellagra, high blood cholesterol, memory loss, fatigue, depression, diarrhea, headache, skin problems, lesion in mouth, tiredness etc.

- ***Vitamin B5 (pantothenic acid): -***

It is also called as pantothenic acid, it is water soluble vitamin, it is a micro nutrient, it is necessary for making blood cells; acts to convert eaten proteins, carbohydrate, fats into energy; it is a component of coenzyme A; it is used in synthesis of coenzyme A. (coenzyme A acts on transport of carbon atoms within the cell).

Main sources of vitamin B5: -

It is present in watermelon, quince, meat, chicken, liver, kidney, fish, grains, milk, dairy products, legumes, pumpkin, grapes etc.

Basic pharmacokinetic of vitamin B5 (based on human intake in natural food products): -

It is converted into free form by intestinal enzymes & in nutritional doses it is absorbed in intestinal cells via sodium dependent active transport system in jejunum & pharmacological doses are absorbed by passive diffusion; after absorption the free form of it is now transported to erythrocytes via plasma, in cells pantothenic acid is converted into CoA, all the body tissues can convert it into CoA & ACP (acyl carrier protein), after these two complete their jobs they are degraded to form free pantothenic acid & other metabolites. It is excreted in urine & stools & little in exhaled in carbon dioxide.

Basic clinical pharmacology of vitamin B5: -

It promotes skin, hair & eyes health, proper functioning of nervous system & liver, formation of red blood cells, making of adrenal hormones, sex hormones; it is very helpful in constipation, rheumatoid arthritis, acne, allergies, asthma, baldness, colitis etc.

Its deficiency causes fatigue, nausea, vomiting, irritability, neurological weakness, numbness, abdominal cramps, sleep disturbances, hypoglycemia etc.

- ***Vitamin B6: -***

It is also called as pyridoxine; it is involved in many aspects of macronutrients metabolism; it is present in many food products naturally.

Main sources of vitamin B6: -

It is present in watermelon, quince, chicken, bread, egg, vegetable, soyabean, whole grain cereals, brown rice, fish, legumes, beef, nuts, beans, liver, citrus fruits, starchy vegetables, potato, cucumber etc.

Basic pharmacokinetic of vitamin B6 (based on human intake in natural food products): -

It is absorbed in small intestines, but before absorption a phosphate group has to be removed making vitamin B 6 in free form & absorbed by passive transport, now reaches liver via portal vein, in liver to get metabolized & flown into the blood stream it is bound with albumin & some are taken up by red blood cells, once getting in blood it can function & promote health & it is excreted mainly in urine & little is excreted in stools, it is very little stored in tissues, muscle tissues, liver, brain, kidneys, spleen.

Basic clinical pharmacology of vitamin B6: -

It is needed for proper development & function of brain in children; it is needed for neurotransmitter, histamine, haemoglobin synthesis & function. It serves as coenzyme (cofactor) for many reactions in the body, it is the master vitamin for processing amino acids & some hormones, it is needed by the body to prepare serotonin, melatonin & dopamine, it is better to intake it during treatment of tuberculosis. It supports adrenal glands to function; it acts as a coenzyme in the breakdown & utilization of fats, carbohydrates, protein, it is important for immune system, it helps in treatment of nerve compression like carpal tunnel syndrome, premenstrual syndrome, depression, arthritis, high homocysteine level, diabetes, asthma, kidney stones etc.

Its deficiency causes seborrheic dermatitis (eruption on skin), atrophic glossitis with ulceration, conjunctivitis, neuropathy, anaemia etc.

- ***Folate (vitamin B9): -***

Folate is an essential micro nutrient, it is a natural form of vitamin B9, it serves many important functions of the body, it plays an important role in cell growth & formation of DNA, RNA & other genetic material & helps in treating many diseases; it name is derived from Latin word Folium, which means leaf, leafy vegetables have it in good amount; Folic acid is a synthetic form of vitamin B9.

Main sources of folate: -

It is present in watermelon, quince, dark green leafy vegetables, fruits, nuts, beans, dates, seafood, egg, dairy products, meat, chicken, legumes, beetroot, citrus fruits, broccoli, spinach, cereals, cucumber etc.

Basic pharmacokinetic of folate (based on human intake in natural food products): -

Its absorption is complicated because folate present in food are of many different forms, some of which cannot be absorbed until broken down by intestinal enzymes; it is not absorbed more than 50%; dietary folate contains glutamate that need to separate it from glutamate before absorption starts; It is absorbed in duodenum & jejunum, after absorption it is converted into tetrahydrofolate (the active form of folate), than a methyl group is added to it to form methyltetrahydrofolate; now the body uses it for various functions & metabolism; the body can store folate 20-70mg in liver which is enough for 3 -6 months for the body; it gets excreted in urine & little in stools & bile.

Basic clinical pharmacology of folate: -

It is needed by the body to make DNA, RNA & other genetic material; it prevents many disease & conditions like anaemia, stroke, cardiac diseases, cancers, neurological diseases, macular degeneration (eye disease), palpitation, sores in mouth & tongue, hair fall, graying of hair. It is important in fertilization in male & female, essential during pregnancy to prevent neural tube defect in embryo (it is needed more), it protect us from free radicals & oxidation thus prevent cancers, it is essential in red blood cells formation, reduces high levels of homocysteine.

Its deficiency may cause anaemia, tiredness, palpitation, breathlessness, hairfall, neural tube defect in baby during pregnancy etc.

- ***Absorption & digestion of amino acid.***

When we eat high-protein foods, body breaks down protein into amino acids and peptides through digestive enzymes, such as pepsin & pancreas produces trypsin, chymotrypsin and other that aid in protein digestion.

Pepsin is the primary enzyme responsible for digesting protein; it acts on the protein molecules & breaks the bonds – called peptide bonds – that hold the protein molecules together. Next, these smaller chains of amino acids move in the stomach & then in small intestine where they're further broken down by enzymes released by the pancreas. Small intestine contains finger-like extensions called micro-villi. These structures enhance its ability to absorb dietary nutrients. Now the semi digested material pass through brush border and baso-lateral membranes of small intestine & di-tripeptides are absorbed by passive transport (facilitated or simple diffusion) or active transport (Na+ or H+ co-transporters) pathways. Di and tripeptides are more efficiently absorbed than free amino acids which in turns are better absorbed than oligopeptides. They're released into the bloodstream and used for various biochemical reactions.

Each amino acid has a different role in the human body. Upon absorption, some amino acids are incorporated into a new protein. Some fuel your muscles and support tissue repair. Others are used as a source of energy.

Tryptophan and tyrosine, for example, promote brain health. These amino acids support the production of neurotransmitters, leading to increased alertness and optimum nerve responses. Tryptophan also assists with serotonin production, lifting your mood and keeping depression at bay.

Phenylalanine serves as a precursor to melatonin, epinephrine, dopamine and other chemicals that regulate your mood and bodily functions. Methionine helps your body absorb selenium and zinc, two

minerals that promote overall health. Some amino acids, such as isoleucine, play a vital role in hemoglobin production and glucose metabolism.

- ***Tryptophan: -***

It is an amino acids (protein) that is useful in bio-synthesis of protein; it is essential in human because body cannot make it); it is a precursor of neuro-transmitter serotonin, melatonin, vitamin B3; it is a sedative also.

Main sources of tryptophan: -

Salmon oil, egg, spinach, milk, seeds, fenugreek seed, soy products, nuts, fish, meat, wheat, banana etc.

Basic pharmacokinetics of tryptophan (based on human intake in natural food products): -

It is absorbed in small intestine & reached the blood circulation, it passes the blood brain barrier & in brain cells it is metabolized into indolamine neuro-transmitter, niacin, a common example of indolamine is serotonin derivative from tryptophan. Tryptophan is converted into serotonin in the brain & body; it is believed that tryptophan supplements should be taken with carbidopa, which blocks the blood brain barrier. (Serotonin (5HTP) 5 hydroxytryptamine, is a monoamine neuro-transmitter. It contributes in feelings of well-being, happiness, reward, learning, memory, many physiological functions).

In the pathway of tryptophan/serotonin, melatonin hormone is produced. Melatonin regulates sleep-wake cycle. It is primarily released by pineal gland in brain. It controls circadian (daily clock) rhythms.

Pineal gland releases it at night more & very little in day light. It improves immune system function.

Natural sources of melatonin are tomato, pomegranate, olive, grapes, broccoli, cucumber, barley, seeds, nuts etc.

Fructose malabsorption causes improper absorption of tryptophan in intestine thus leading to low level of it & may cause depression.

Basic clinical pharmacology of tryptophan: -

It is necessary for normal growth of infants; nitrogen balance in adults, it aids in sleep pattern, mood. It is necessary for melatonin & serotonin formation in body, it enhances mental & emotional wellbeing, manages pain tolerance, weight etc. it also helps in build muscle tissue, essential for vitamin B3 production, relives insomnia, reduces anxiety, depression, migraine, OCD, helps immune system, reduces cardiac spasms, improves sleep patter etc.

- ***Threonine: -***

It is an amino acid used in biosynthesis of proteins; it is an essential amino acid important for tooth enamel, collagen, elastin, nervous system, fats metabolism, it prevents fats buildup in liver, useful in intestinal disorders, anxiety, and depression.

Main sources of threonine: -

Cheese, chicken, fish, meat, lentil, black seed, nuts, soy etc.

Basic clinical pharmacology of threonine: -

It is useful in nervous system disorders, multiple sclerosis, spinal spasticity, makes bones, joints, tendons, ligament stronger, it helps the immune system, promotes heart health.

- ***Isoleucine: -***

It is an amino acid that is used in the biosynthesis of proteins, it is an essential amino acid means the body cannot make it & we depend on food sources, it plays & helps many functions of the body.

Main sources of isoleucine: -

Meat, mutton, fish, cheese, egg, seeds, nuts, soybeans, milk, legumes, fenugreek seed etc.

Basic pharmacokinetics of isoleucine (based on human intake in natural food products): -

It is absorbed in small intestine by sodium-dependant active transport. It is metabolized in liver.

Basic clinical pharmacology of isoleucine: -

It promotes glucose consumption 7 uptake, it is anti-catabolic, enhances athletic performance & best for pre-workout, it acts on wound healing, detox of nitrogenous waste in the body, stimulates immune system, promotes secretion of many hormones, helps in heamoglobin formation, regulating blood glucose, energy in the body, built muscles, helpful to brain for its function.

- ***Leucine: -***

It is branched chain amino acid (BCAA) it is ketogenic amino acid; it is necessary when we do exercise, it stimulates protein synthesis & assists in muscle building.

Main sources of leucine: -

Cheese, soyabean, meat, nuts, chicken, seeds, fish, seafood, beans.

Basic clinical pharmacology of leucine: -

It helps regulate blood glucose, promotes growth, recovers the muscles & bone tissues, acts on production of growth hormones, repairs the tissues, essential for muscle building, it burns fats, controls obesity, promotes lean muscles growth.

- ***Lysine: -***

It is an essential amino acid, which our body cannot prepare and we need to eat it from food sources. It necessary for many body functions, acts in building blocks of protein (muscles).

Main sources of lysine: -

Red meat, chicken, egg, fish, beans, lentils, wheat germ, nuts, soybeans, spirulina, fenugreek seed, shrimp, pumpkin seed, tuna, cheese, milk etc.

Basic pharmacokinetics of lysine (based on human intake in natural food products): -

It is absorbed from the lumen of the small intestine into the enterocytes by active transport, it undergo first pass metabolism in liver & is metabolized in liver.

Basic clinical pharmacology of lysine: -

It helps the body in tissue growth, repair muscles injury, promote collagen formation, help the body to produce enzymes, antibodies, hormones, supports immune system, its deficiency causes fatigue, irritability, nausea, hair loss, anorexia, inhibited growth, anemia, problems with reproductive system, it is very helpful in treating cold sores (herpes), control blood pressure, diabetes, osteoporosis, helps athletes performance, helpful in treating cancers, reduces anxiety, increase absorption of calcium, improves digestion & prevent leaky gut, helpful in pancreatitis.

- ***Methionine: -***

It is a sulfur containing amino acid; it is essential; it plays a critical role in the metabolism & health; it act on normal cell functioning, growth & repair. It is also a chelating agent for heavy metals; due to its sulfur contain it is helpful in hair, nail health & growth & good for skin health; it reduces cholesterol by increase the production of lecithin in liver & reduces fats formation in liver, also protects kidneys, liver from hepatotoxins, it is an antioxidant. It is absorbed in lumen of small intestines into enterocytes by active transport & metabolized in liver.

Main sources of methionine: -

Meat, mutton, fish, chicken, cheese, egg, beans, milk, nuts, shellfish etc.

- ***Cystine: -***

It is the oxidized dimer form of amino acid, it is nonessential; the body uses it to produce taurine & other amino acids; it is a sulfur containing amino acid; our body uses vitamin B6 with the help of cystine; it heals burns, wounds, bronchitis, assist in supply of insulin, it increase level of glutathione in liver, lungs, kidneys & bone marrow. It is anti-aging, anti-inflammatory, anti-arthritis, anti-rheumatoid arthritis.

Main sources of cystine: -

Meat, egg, milk, garlic, onion, broccoli, oats, wheat germ, lentils etc.

- ***Phenylalanine: -***

It is an aromatic essential amino acid in human; it plays a key role in biosynthesis of other amino acids; it is important in the structure & function of many proteins & enzymes. It is precursor of melanin, dopamine, noradrenalin hormone, thyroxin hormone. It is converted in tyrosine & used in biosynthesis of dopamine & noradrenalin. It improves memory, reduces pain of hunger; it is anti-depressant; it is also a building block protein; it is useful in vitiligo, depression, ADHA, parkinson's, multiple sclerosis, pain, osteoarthritis, rheumatoid arthritis, fat burn & helpful in alcohol withdrawal symptoms.

Main sources of phenylalanine: -

Pumpkin seed, nuts, seeds, soy, meat, fish, chicken, egg, beans, milk etc.

- ***Tyrosine: -***

It is a nonessential amino acid; it is also called as 4-hydroxyphenylalanine; it is useful in cell synthesis of protein; it is a building block protein; body prepares it from phenylalanine. It is a precursor & used to produce noradrenalin, dopamine, & thyroxin & melanin hormones. It reduces stress, improves memory, it promotes growth, mental health, skin health, fat burn. It acts as a mood elevator, anti-depressant, improves memory, mental alertness, its deficiency can cause hypothyroidism leading to low blood pressure, low body temperature (hypothermia), stress, fatigue, narcolepsy; it helps thyroid gland, adrenal gland, pituitary gland to function properly. It is absorbed in small intestine by sodium-dependant active transport; after absorption it reaches the blood & crosses the blood brain barrier (BBB) & enters the brain cells & gets metabolized into catecholamine (noradrenalin). Human body regulates it amount by eating it by food sources & making inside the body (nonessential). The body does not store it much for later uses.

Main sources of tyrosine: -

Meat, fish, egg, milk, nuts, beans, oats, wheat, black seeds etc.

Dopamine: -

It regulates reward & pleasure centers in brain; it is a chemical important for memory, motor skills & etc.

Nor-adrenaline & adrenaline: -

These hormones are responsible for fight & flight response in stressful situation & also controls many functions of the body; it is secreted by adrenal glands.

Thyroxin: -

It is secreted by thyroid gland; it regulates metabolism, blood pressure, digestion, energy etc.

Melanin: -

It is pigmented hormone, gives our skin, hair, eye their colour; dark skinned people have more melanin in their skin than light skin people (depend on exposure to sunlight).

- ***Valine: -***

It is an essential nutrient for vertebrates, biosynthesis of protein; it is an aliphatic & extremely hydrophobic essential amino acid; it is branched chain of amino acid (BCAA); it is important for growth, repair, blood glucose regulation, for energy; it stimulates CNS, proper mental function.

Main sources of valine: -

Cheese, soy, beans, nuts, fish, meat, chicken, mushroom, seeds, nuts, whole grains etc.

- ***Histidine: -***

It is an amino acid used in biosynthesis of protein; it is semi essential amino acid, needed by human for production of histamine & also for growth & tissue repair, it is helpful in maintaining myelin sheaths that covers the nerves & protects the nerves.

Main sources of histidine: -

Meat, mutton, fish, milk, egg, seeds, nuts, chicken, cheese, soy, beans, whole grains, fenugreek seeds.

Basic pharmacokinetics of histidine (based on human intake in natural food products): -

It is absorbed in small intestine via active transport requiring the presence of sodium.

Basic clinical pharmacology of histidine: -

It plays many roles in immunity, gastric secretion & sexual functions. It is also required for blood cell formation & protects tissues against damage of radiation & heavy metals. It keeps normal pH of 7 in the body, useful in rheumatoid arthritis, allergy, ulcer & anemia caused by kidney failure or dialysis. It is an antioxidant, anti-inflammatory, reduces cholesterol.

- ***Arginine: -***

It is among conditional essential amino acid the body needs to function properly; it is made in liver; it plays an important role in building protein thus helpful in body building.

Main sources of arginine: -

Chicken, pumpkin seeds, spirulina, dairy products, red meat, fish, egg etc.

Basic pharmacokinetics of arginine (based on human intake in natural food products): -

It is absorbed in jejunum mainly from oral diet.

Basic clinical pharmacology of arginine: -

It releases nitric oxide in the blood & nitric oxide dilates the blood vessels thus increases the blood supply & controls high blood pressure, it improves erection, builds muscles etc. it also act on release of growth hormone, insulin & other substances in the body. It also improves heart health, athletes performance, stimulates immune system; citrulline present in watermelon is converted into arginine in kidneys, please refer lesson on watermelon.

- ***Alanine: -***

It is a non-essential amino acids that is present in blood plasma in its free state in high levels; it is involved in sugar & acid metabolism, protein synthesis, it increases immunity, provides energy for muscles tissues, brain & CNS, it act on tryptophan, vitamin B6 metabolism; it is an important sources of energy for muscles; it helps the body to convert simple sugar (glucose) into energy; it is produced in the body. It increases exercise capacity; reduces muscle fatigue, boost immunity, it is antioxidant; anti-aging; increases muscle growth; ideal pre & post workout, reduce blood sugar, prevent liver disease, helps the liver to eliminate toxins, improves CNS functioning, helpful in benign prostate hypertrophy. It is digested in small intestine; it is converted into pyruvic acid by alanine aminotransferase-1; during fasting condition alanine derived from protein breakdown is converted into pyruvate & used to synthesis glucose by gluconeogenesis in liver, it is excreted in urine via urea cycle. It is stored little in skeletal muscles.

Main sources of alanine: -

Meat, fish, egg, milk, aleovera, honey, black seeds, nuts etc.

- ***Aspartic acid: -***

It is a non-essential amino acid; it is over all negatively charged & plays an important role in synthesis of other amino acid, citric acid & urea cycles; it is found in animals, plants, sugarcane, sugarbeet. It may be a neurotransmitter; it strengthens the muscles, improves heart function, helps in maintaining mental health, reduces tiredness, improves athletic performance, increases muscle size, reduces depression & fatigue. It is absorbed in small intestine by active transport.

Main sources of aspartic acid: -

Meat, oysters, seeds, oats, avocado, sugar beet, milk, egg, nuts, cereals etc.

- ***Glutamic acid: -***

It is a nonessential amino acid. It is an excitatory neuro-transmitter; it is necessary for biosynthesis of proteins; body uses it for several key functions within the body like making other neuro-transmitters such as GABA; it promotes brain health, muscles health, intelligence, mood & mental alertness. It is called as chemical messenger. It plays an important role in body's disposal of excessive waste like nitrogen. It is absorbed in lumen of small intestine into enterocytes by active transport & excreted in urine mainly. It is almost about 2 kgs, storage in natural form in brain, kidneys, liver, muscles etc.

Main sources of glutamic acid: -

Meat, chicken, fish, egg, milk, wheat, mushroom, soy, broccoli, walnut, peas etc.

- ***Glycine: -***

It is a nonessential amino acid that body needs for growth & maintenances of tissue & need to prepare hormones & enzymes. It is inhibitory neurotransmitter. It helps in preparing glutathione (a powerful antioxidant & reduces free radicals, delay aging). It is helpful in preparing of creatine (provides energy to muscles to perform exercise etc & acts on muscle contraction), beneficial for brain health, bone health, alzheimer's, schizophrenia, sleep disorder, stroke, burns, protects kidney & liver from harmful side effects of drugs used after organ transplant, heals wound & ulcers, it is anti-inflammatory, improves skin health.

Main sources of glycine: -

Meat, fish, milk, legumes etc.

- ***Proline: -***

It is a protein-genic amino acid used in biosynthesis of proteins. It heals cartilages, cushion joints, tendons, ligament, heart muscles, connective tissues & helps in formation of collagen.

Main sources of proline: -

Soy, pumpkin seed, lentils, black beans, quinoa etc.

- ***Serine:-***

It is a nonessential amino acid, important for synthesis of protein, fats metabolism, muscle growth, immune system; it is a precursor of many amino acids, helpful in enzyme catalyze its reaction, overall health, physical & mental health.

Main sources of serine: -

Soybean, egg, lentils, meat, fish, nuts, almonds, walnut etc.

- ***Asparagine: -***

It is a non-essential amino acid; it acts on biosynthesis of proteins; it is a nontoxic carrier of residual ammonia to be eliminated from the body; it acts as diuretic also; it helps cell, nerve, brain to function. It is helpful to nervous system, reduces fatigue, helps in building muscles, improves liver function, protects liver, beneficial for nerve cells & brain; increases stamina, help in synthesis of various enzymes, proteins, glycoprotein etc.

- ***Main sources of asparagine: -***

Milk, meat, egg, fish, soy, potato, legumes, nuts, seeds etc.

Nutrients	*Cichorium intybus*
Proximate analysis (g/100 g)	
Dry matter	81.7
Crude fiber	4.01
Carbohydrates	4.70
Crude protein	1.70
Ether extract	0.30
Metabolisable energy (kcal)	23.0
Mineral analysis (g/100 g)	
Magnesium	30.0
Phosphorus	47.0
Calcium	100
Zinc	0.33
Sodium	45.0
Iron	0.90
Vitamin analysis	
Vitamin A (µg)	286
Vitamin E (mg)	2.26
Vitamin K (µg)	296
Vitamin C (mg)	22.0
Vitamin B_1 (mg)	0.06
Vitamin B_2 (mg)	0.01
Vitamin B_3 (mg)	0.05
Vitamin B_5 (mg)	1.16
Vitamin B_6 (mg)	0.11
Vitamin B_9 (µg)	107

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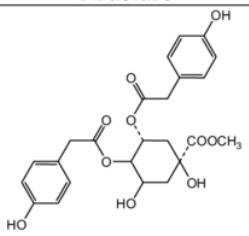
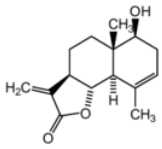
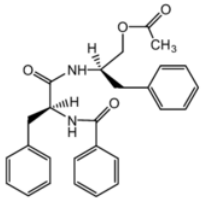
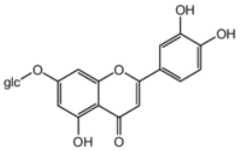
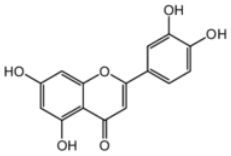
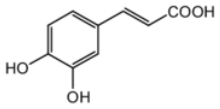
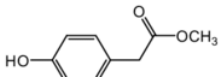
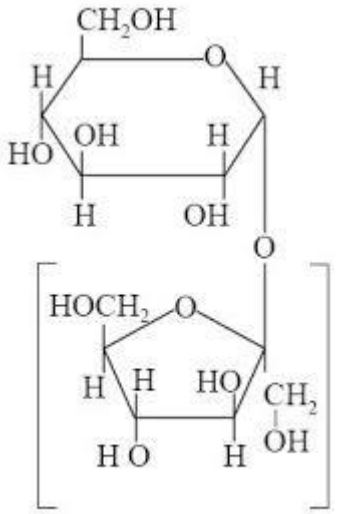
2	Intyboate B	
5	3a*R*-santamarine	
6	Aurantiamide acetate	
7	Luteolin-7-*O*-β-D-glucoside	
8	Luteolin	
9	Caffeic acid	
10	Methyl 4-hydroxyphenylacetate	



Inulin

- ***References: -***

M. I. Massoud, W. A. Amin, and A. A. Elgindy, "Chemical and technological studies on Chicory (Cichorium Intybus L) and its applications in some functional food," Journal of Advanced Agricultural Research, vol. 14, no. 3, pp. 735–756, 2009.View at: Google Scholar

H. P. Bais and G. A. Ravishankar, "Cichorium intybus L.—cultivation, processing, utility, value addition and biotechnology, with an emphasis on current status and future prospects," Journal of the Science of Food and Agriculture, vol. 81, no. 5, pp. 467–484, 2001.View at: Publisher Site | Google Scholar

S. Chandra, M. Kumar, P. Dwivedi, and K. Arti, "Studies on industrial importance and medicinal value of chicory plant (Cichorium intybus L.)," International Journal of Advance Research, vol. 4, no. 1, pp. 1060–1071, 2016.View at: Google Scholar

T. W. Schillhorn van Veen, "Sense or nonsense? Traditional methods of animal disease prevention and control in the African savannah," in Ethnoveterinary Research and Development, pp. 25–36, Intermediate Technology Publications, London, UK, 1996.View at: Google Scholar

D. Van der Merwe, G. E. Swan, and C. J. Botha, “Use of ethnoveterinary medicinal plants in cattle by Setswana-speaking people in the Madikwe area of the North West Province of South Africa,” Journal of the South African Veterinary Association, vol. 72, no. 4, pp. 189–196, 2001.View at: Google Scholar
H. H. Baek and K. R. Cadwallader, “Roasted chicory aroma evaluation by gas chromatography/mass spectrometry/olfactometry,” Journal of Food Science, vol. 63, no. 2, pp. 234–237, 1998.View at: Google Scholar
B. F. Desprez, L. Delesalle, C. Dhellemmes, M. F. Desprez, C. Rambaud, and J. Vasseur, “Genetics and breeding of industrial chicory, a historical review,” in Proceedings of the Eighth Seminar on Inulin, Lille, France, 1999.View at: Google Scholar
J. T. C. Leite Toneli, F. E. X. Mürr, P. Martinelli, I. M. Dal Fabbro, and K. J. Park, “Optimization of a physical concentration process for inulin,” Journal of Food Engineering, vol. 80, no. 3, pp. 832–838, 2007.View at: Publisher Site | Google Scholar
S. Varotto, M. Lucchin, and P. Parrini, “Immature embryos culture in Italian red chicory (Cichorium intybus C),” Plant Cell, Tissue and Organ Culture, vol. 62, no. 1, pp. 75–77, 2000.View at: Publisher Site | Google Scholar
H. Hoste, F. Jackson, S. Athanasiadou, S. M. Thamsborg, and S. O. Hoskin, “The effects of tannin-rich plants on parasitic nematodes in ruminants,” Trends in Parasitology, vol. 22, no. 6, pp. 253–261, 2006.View at: Publisher Site | Google Scholar
S. Das, N. Vasudeva, and S. Sharma, “Cichorium intybus: a concise report on its ethnomedicinal, botanical, and phytopharmacological aspects,” Drug Development and Therapeutics, vol. 7, no. 1, pp. 1–12, 2016.View at: Google Scholar
Y. Hui Ru, H. Shaoh, and Y. Yingli, “The extraction and purification of inulin,” Natural Product Research and Development, vol. 14, p. 65, 2002.View at: Google Scholar
M. Kim and H. K. Shin, “The water-soluble extract of chicory reduces glucose uptake from the perfused jejunum in rats,” Journal of Nutrition, vol. 126, pp. 2236–2242, 1996.View at: Google Scholar
L. Madrigal and E. Sangronis, “Inulin and derivates as key ingredients in functional foods: a review,” Archivos Latinoamericanos de Nutrición, vol. 57, pp. 387–396, 2007.View at: Google Scholar
K. J. Park, R. A. de Oliveira, and F. P. R. Brod, “Drying operational parameters influence on chicory roots drying and inulin extraction,” Food and Bioproducts Processing, vol. 85, no. 3 C, pp. 184–192, 2007.View at: Publisher Site | Google Scholar
D. Li, J. M. Kim, Z. Jin, and J. Zhou, “Prebiotic effectiveness of inulin extracted from edible burdock,” Anaerobe, vol. 14, no. 1, pp. 29–34, 2008.View at: Publisher Site | Google Scholar
C. D. Waugh, D. Clark, S. L. Harris, E. R. Thom, Copemanand. P. J. A., and A. R. Napper, “Chicory for milk production,” Proceedings of the New Zealand Grassland Association, vol. 60, pp. 33–37, 1998.View at: Google Scholar
O. Tzamaloukas, S. Athanasiadou, I. Kyriazakis, J. F. Huntley, and F. Jackson, “The effect of chicory (Cichorium intybus) and sulla (Hedysarum coronarium) on larval development and mucosal cell responses of growing lambs challenged with Teladorsagia circumcincta,” Parasitology, vol. 132, no. 3, pp. 419–426, 2006.View at: Publisher Site | Google Scholar
F. Heckendorn, D. A. Häring, V. Maurer, J. Zinsstag, W. Langhans, and H. Hertzberg, “Effect of sainfoin (Onobrychis viciifolia) silage and hay on established populations of Haemonchus contortus and Cooperia curticei in lambs,” Veterinary Parasitology, vol. 142, no. 3-4, pp. 293–300, 2006.View at: Publisher Site | Google Scholar
J. Van Loo, “How chicory fructans contribute to zootechnical performance and well-being in livestock and companion animals,” Journal of Nutrition, vol. 137, no. 11, pp. 2594S–2597S, 2007.View at: Google Scholar
S. Athanasiadou, J. Githiori, and I. Kyriazakis, “Medicinal plants for helminth parasite control: Facts and fiction,” Animal, vol. 1, no. 9, pp. 1392–1400, 2007.View at: Publisher Site | Google Scholar
B. Margett and J. Buttriss, “Epidemiology linking consumption of plant foods and their constituents with health,” in Plants: Diet and health, pp. 49–60, Blackwell Publishing, Oxford, UK, 2003.View at: Google Scholar
C. Carazzone, D. Mascherpa, G. Gazzani, and A. Papetti, “Identification of phenolic constituents in red chicory salads (Cichorium intybus) by high-performance liquid chromatography with diode array detection and electrospray ionisation tandem mass spectrometry,” Food Chemistry, vol. 138, no. 2-3, pp. 1062–1071, 2013.View at: Publisher Site | Google Scholar
T. Tsuda, F. Horio, K. Uchida, H. Aoki, and T. Osawa, “Dietary cyanidin 3-O-β-D-glucoside-rich purple corn color prevents obesity and ameliorates hyperglycemia in mice,” Journal of Nutrition, vol. 133, no. 7, pp. 2125–2130, 2003.View at: Google Scholar
J. Wang and G. Mazza, “Effects of anthocyanins and other phenolic compounds on the production of tumor necrosis factor α in LPS/IFN-γ-activated RAW 264.7 macrophages,” Journal of Agricultural and Food Chemistry, vol. 50, no. 15, pp. 4183–4189, 2002.View at: Publisher Site | Google Scholar
K. A. Youdim, J. McDonald, W. Kalt, and J. A. Joseph, “Potential role of dietary flavonoids in reducing microvascular endothelium vulnerability to oxidative and inflammatory insults,” The Journal of Nutritional Biochemistry, vol. 13, no. 5, pp. 282–288, 2002.View at: Publisher Site | Google Scholar
H. P. S. Makkar, “Effects and fate of tannins in ruminant animals, adaptation to tannins, and strategies to overcome detrimental effects of feeding tannin-rich feeds,” Small Ruminant Research, vol. 49, no. 3, pp. 241–256, 2003.View at: Publisher Site | Google Scholar
“Images for chicory parts and uses,” https://en.wikipedia.org/wiki/Chicory.View at: Google Scholar
“Chicory management,” in Farmfacts, DairyNZ, 2013.View at: Google Scholar
A. K. Nadkarni, Indian Materia, Medica, Bombay, India, 1976.
P. S. Varier, “Cichorium intybus Linn,” in Indian Medicinal Plants a Compendium of 500 Species, p. 74, Orient Longman, Chennai, India, 1994.View at: Google Scholar
R. G. Wilson, J. A. Smith, and C. D. Yonts, “Chicory root yield and carbohydrate composition is influenced by cultivar selection, planting, and harvest date,” Crop Science, vol. 44, no. 3, pp. 748–752, 2004.View at: Publisher Site | Google Scholar
S. Soobo, Effects of prebiotics, probiotics andsynbiotics in the diet of young pigs [Ph.D. thesis], Wageningen University, Wageningen, Netherlands, 2005.
C. F. Phelps, “The physical properties of inulin solutions,” Biochemical Journal, vol. 95, pp. 41–47, 1965.View at: Publisher Site | Google Scholar
A. M. Peters and A. Van Amerongen, “Relationship between levels of sesquiterpene lactones in chicory and sensory evaluation,” Journal of the American Society for Horticultural Science, vol. 123, no. 2, pp. 326–329, 1998.View at: Google Scholar
J.-W. De Kraker, M. C. R. Franssen, A. De Groot, W. A. König, and H. J. Bouwmeester, “(+)-Germacrene A biosynthesis - The committed step in the biosynthesis of bitter sesquiterpene lactones in chicory,” Plant Physiology, vol. 117, no. 4, pp. 1381–1392, 1998.View at: Publisher Site | Google Scholar
S. Nandagopal and B. D. Kumari, “Phytochemical and antibacterial studies of chicory (CichoriumintybusL.) A multipurpose medicinal plant,” Advances in Biological Research, vol. 1, no. 1-2, pp. 17–21, 2007.View at: Google Scholar
H. Hussain, J. Hussain, M. Saleem et al., “Cichorin A: A new benzo-isochromene from Cichorium intybus,” Journal of Asian Natural Products Research, vol. 13, no. 6, pp. 566–569, 2011.View at: Publisher Site | Google Scholar
H. Hussain, J. Hussain, S. Ali et al., “Cichorins B and C: Two new benzo-isochromenes from Cichorium intybus,” Journal of Asian Natural Products Research, vol. 14, no. 4, pp. 297–300, 2012.View at: Publisher Site | Google Scholar
G. W. Ying and L. J. Gui, “Chicory seeds: a potential source of nutrition for food and feed,” Journal of Animal and Feed Sciences, vol. 13, no. 2, pp. 1736–1746, 2012.View at: Google Scholar
M. F. Marcone, F. Jahaniaval, H. Aliee, and Y. Kakuda, “Chemical characterization of Achyranthes bidentata seed,” Food Chemistry, vol. 81, no. 1, pp. 7–12, 2003.View at: Publisher Site | Google Scholar
L. Plaza, B. De Ancos, and M. P. Cano, “Nutritional and health-related compounds in sprouts and seeds of soybean (Glycine max), wheat (Triticum aestivum.L) and alfalfa (Medicago sativa) treated by a new drying method,” European Food Research and Technology, vol. 216, no. 2, pp. 138–144, 2003.View at: Publisher Site | Google Scholar
B. Ahmed, S. Khan, M. H. Masood, and A. H. Siddique, “Anti-hepatotoxic activity of cichotyboside, a sesquiterpene glycoside from the seeds of Cichorium intybus.,” Journal of Asian Natural Products Research, vol. 10, no. 3-4, pp. 223–231, 2008.View at: Google Scholar

R. Nørbæk, K. Nielsen, and T. Kondo, "Anthocyanins from flowers of Cichorium intybus," Phytochemistry, vol. 60, no. 4, pp. 357–359, 2002.View at: Publisher Site | Google Scholar
A. Judžentiene and J. Budiene, "Volatile constituents from aerial parts and roots of Cichorium intybus L. (chicory) grown in Lithuania," Chemija, vol. 19, no. 2, pp. 25–28, 2008.View at: Google Scholar
Z. K. Abbas, S. Saggu, M. I. Sakeran, N. Zidan, H. Rehman, and A. A. Ansari, "Phytochemical, antioxidant and mineral composition of hydroalcoholic extract of chicory (Cichorium intybus L.) leaves," Saudi Journal of Biological Sciences, vol. 22, no. 3, pp. 322–326, 2014.View at: Publisher Site | Google Scholar
M. Ćustić, M. Poljak, and N. Toth, "Effects of nitrogen nutrition upon the quality and yield of head chicory (Cichorium intybus L. var.foliosum)," Acta Horticulturae, vol. 533, pp. 401–410, 2000.View at: Publisher Site | Google Scholar
V. Mulabagal, H. Wang, M. Ngouajio, and M. G. Nair, "Characterization and quantification of health beneficial anthocyanins in leaf chicory (Cichorium intybus) varieties," European Food Research and Technology, vol. 230, no. 1, pp. 47–53, 2009.View at: Publisher Site | Google Scholar
J. M. Drazen, "Inappropriate advertising of dietary supplements," The New England Journal of Medicine, vol. 348, no. 9, pp. 777-778, 2003.View at: Publisher Site | Google Scholar
R. A. Street, J. Sidana, and G. Prinsloo, "Cichorium intybus: Traditional uses, phytochemistry, pharmacology, and toxicology," Evidence-Based Complementary and Alternative Medicine, vol. 2013, Article ID 579319, 2013.View at: Publisher Site | Google Scholar
H. Mejer, Transmission, infection dynamics and alternative control of helminths in organic swine [Ph.D. thesis], Danish Centre for Experimental Parasitology, Royal Veterinary and Agricultural University, 2006.
M. B. Roberfroid, "Inulin-type fractans: functional food ingredients," The Journal of Nutrition, vol. 137, pp. 2493S–2502S, 2007.View at: Google Scholar
M. B. Roberfroid, "Prebiotics: preferential substrates for specific germs?" American Journal of Clinical Nutrition, vol. 73, no. 2, pp. 406S–409S, 2001.View at: Google Scholar
N. Kaur and A. K. Gupta, "Applications of inulin and oligofructose in health and nutrition," Journal of Biosciences, vol. 27, no. 7, pp. 703–714, 2002.View at: Publisher Site | Google Scholar
H. Liu, E. Ivarsson, J. Dicksved, T. Lundh, and J. E. Lindberg, "Inclusion of Chicory (Cichorium intybus L.) in pigs' diets affects the intestinal microenvironment and the gut microbiota," Applied and Environmental Microbiology, vol. 78, no. 12, pp. 4102–4109, 2012.View at: Publisher Site | Google Scholar
M. B. Roberfroid, J. Cumps, and J. P. Devogelaer, "Dietary chicory inulin increases whole-body bone mineral density in growing male rats," Journal of Nutrition, vol. 132, no. 12, pp. 3599–3602, 2002.View at: Google Scholar
M. T. Jensen and L. L. Hansen, "Feeding with chicory roots reduces the amount of odorous compounds in colon and rectal contents of pigs," Journal of Animal Science, vol. 82, no. 3, pp. 369–376, 2006.View at: Publisher Site | Google Scholar
M. Rasmussen, Regulation of porcine hepatic cytochrome P450 by chicory root implication for boar taint [Ph.D. thesis], Department of Food Science, Faculty of Science and Technology, Aarhus University, Aarhus, Denmark, 2012.
M. Saeed, M. E. Abd El-Hac, M. Alagawany et al., "Chicory (Cichorium intybus) Herb: chemical composition, pharmacology, nutritional and healthical applications," International Journal of Pharmacology, vol. 13, no. 4, pp. 351–360, 2017.View at: Publisher Site | Google Scholar
A. I. Hassan, S. A. Osman, M. H. Al-Gaabary, and K. M. Abo El-Soud, "Effects of chicory (Cichoriumintybus) and Artemisiaabsenthium extracts against ovine gastrointestinal nematodes," International Journal of Food, Agriculture and Veterinary Sciences, vol. 4, no. 2, pp. 43–53, 2014.View at: Google Scholar
M. Peña-Espinoza, S. M. Thamsborg, O. Desrues, T. V. A. Hansen, and H. L. Enemark, "Anthelmintic effects of forage chicory (Cichorium intybus) against gastrointestinal nematode parasites in experimentally infected cattle," Parasitology, vol. 143, no. 10, pp. 1279–1293, 2016.View at: Publisher Site | Google Scholar
J. Milala, K. Grzelak, B. Król, J. Juśkiewicz, and Z. Zduńczyk, "Composition and properties of chicory extracts rich in fructans and polyphenols," Polish Journal of Food and Nutrition Sciences, vol. 59, no. 1, pp. 35–43, 2009.View at: Google Scholar
M. Kim, "The water-soluble extract of chicory reduces cholesterol uptake in gut- perfused rats," Nutrition Research, vol. 20, no. 7, pp. 1017–1026, 2000.View at: Publisher Site | Google Scholar
B. Ahmed, T. A. Al-Howiriny, and A. B. Siddiqui, "Antihepatotoxic activity of seeds of Cichorium intybus," Journal of Ethnopharmacology, vol. 87, no. 2-3, pp. 237–240, 2003.View at: Publisher Site | Google Scholar
A. Papetti, M. Daglia, P. Grisoli, C. Dacarro, C. Gregotti, and G. Gazzani, "Anti- and pro-oxidant activity of Cichorium genus vegetables and effect of thermal treatment in biological systems," Food Chemistry, vol. 97, no. 1, pp. 157–165, 2006.View at: Publisher Site | Google Scholar
W. Peschel, F. Sánchez-Rabaneda, W. Diekmann et al., "An industrial approach in the search of natural antioxidants from vegetable and fruit wastes," Food Chemistry, vol. 97, no. 1, pp. 137–150, 2006.View at: Publisher Site | Google Scholar
M. Wang, J. E. Simon, I. F. Aviles, K. He, Q.-Y. Zheng, and Y. Tadmor, "Analysis of antioxidative phenolic compounds in artichoke (Cynara scolymus L.)," Journal of Agricultural and Food Chemistry, vol. 51, no. 3, pp. 601–608, 2003.View at: Publisher Site | Google Scholar
M. Innocenti, S. Gallori, C. Giaccherini, F. Ieri, F. F. Vincieri, and N. Mulinacci, "Evaluation of the phenolic content in the aerial parts of different varieties of Cichorium intybus L.," Journal of Agricultural and Food Chemistry, vol. 53, no. 16, pp. 6497–6502, 2005.View at: Publisher Site | Google Scholar
D. Mares, C. Romagnoli, B. Tosi, E. Andreotti, G. Chillemi, and F. Poli, "Chicory extracts from Cichorium intybus L. as potential antifungals," Mycopathologia, vol. 160, no. 1, pp. 85–92, 2005.View at: Publisher Site | Google Scholar
E. Ivarsson, B. E. Frankow-Lindberg, H. K. Andersson, and J. E. Lindberg, "Growth performance, digestibility and faecal coliform bacteria in weaned piglets fed a cereal-based diet including either chicory (Cichorium intybus L) or ribwort (Plantago lanceolata L) forage," Animal, vol. 5, no. 4, pp. 558–564, 2011.View at: Publisher Site | Google Scholar
S. Petkevicius, K. Knudsen, P. Nansen, A. Roepstorff, F. Skjoth, and K. Jensen, "The impact of diets varying in carbohydrates resistant to endogenous enzymes and lignin on populations of Ascarissuum and Oesophagostomumdentatum in pigs," Parasitology, vol. 114, no. 6, pp. 555–568, 1997.View at: Google Scholar
L. E. Thomsen, S. Petkevičius, K. E. Bach Knudsen, and A. Roepstorff, "The influence of dietary carbohydrates on experimental infection with Trichuris suis in pigs," Parasitology, vol. 131, no. 6, pp. 857–865, 2005.View at: Publisher Site | Google Scholar
C. L. Marley, R. Cook, R. Keatinge, J. Barrett, and N. H. Lampkin, "The effect of birdsfoot trefoil (Lotus corniculatus) and chicory (Cichorium intybus) on parasite intensities and performance of lambs naturally infected with helminth parasites," Veterinary Parasitology, vol. 112, no. 1-2, pp. 147–155, 2003.View at: Publisher Site | Google Scholar
G. Li and P. D. Kemp, "Forage Chicory (Cichorium intybus L.): a review of its agronomy and animal production," Advances in Agronomy, vol. 88, pp. 187–222, 2005.View at: Publisher Site | Google Scholar
A. Kidane, J. G. M. Houdijk, S. Athanasiadou, B. J. Tolkamp, and I. Kyriazakis, "Effects of maternal protein nutrition and subsequent grazing on chicory (Cichorium intybus) on parasitism and performance of lambs," Journal of Animal Science, vol. 88, no. 4, pp. 1513–1521, 2010.View at: Publisher Site | Google Scholar
D. Lombardi, E. Vasseur, R. Berthiaume, T. J. DeVries, and R. Bergeron, "Feeding preferences and voluntary feed intake of dairy cows: effect of conservation and harvest time of birdsfoot trefoil and chicory," Journal of Dairy Science, vol. 98, no. 10, Article ID 73852, pp. 7238–7247, 2015.View at: Publisher Site | Google Scholar
M. C. Miller, S. K. Duckett, and J. G. Andrae, "The effect of forage species on performance and gastrointestinal nematode infection in lambs," Small Ruminant Research, vol. 95, no. 2-3, pp. 188–192, 2011.View at: Publisher Site | Google Scholar

- ***Research: -***

Pharmacological effects: Hepatoprotective effect:

The hepatoprotective activity of aqueous-methanolic extract of Cichorium intybus seeds was investigated against acetaminophen and CCl4-induced hepatic damage. Acetaminophen produced 100% mortality at the dose of 1 g/kg in mice while

pretreatment of animals with plant extract (500mg/kg) reduced the death rate to 30%. Acetaminophen at the dose of 640 mg/kg produced liver damage in rats as manifested by the significant (P < 0.01) rise in serum levels of alkaline phosphatase (ALP), GOT and GPT to 393 ± 28, 767 ± 215 and 692 ± 191 IU/l respectively, compared to respective control values of 198 ± 15, 76 ± 07 and 39 ± 09 IU/l. Pretreatment of rats with plant extract (500 mg/kg) significantly lowered (P< 0.01) in Na+ and K+ levels, as well as the sex ratio of male to female offspring (10.23%)(92).

Hypoglycemic and hypolipidemic effects:

Ischemic manifestations and cerebral dysfunction have been demonstrated in diabetes. Otherwise, the impairment in the glycemic control is the basic mechanism causing inhibition of neuronal activity. Cerebral extract from alloxan diabetic rats significantly inhibited the brain AChE activity of normal animals, indicating the presence of an inhibiting factor in the cerebrum of diabetic rats. Cichorium intybus when fed for 10 days offered neuroprotection in diabetic rats by stimulating AChE activity. The hypoglycemic and hypolipidemic properties of an ethanolic extract of Cichorium intybus (CIE) was studied in rats. Male Sprague-Dawley rats aged 9 weeks were administered with streptozotocin (STZ, 50mg/kg) intraperitoneally to induce experimental diabetes. The Cichorium intybus whole plant (CIE) was exhaustively extracted with 80% ethanol. Hypoglycemic effects of CIE were observed in an oral glucose tolerance test (OGTT). A dose of 125 mg of plant extract/kg bw exhibited the most potent hypoglycemic effect. Moreover, daily administration of CIE (125 mg/kg) for 14 days to diabetic rats attenuated serum glucose by 20%, triglycerides by 91% and total cholesterol by 16%. However, there was no change in serum insulin levels, which ruled out the possibility that CIE induced insulin secretion from pancreatic beta-cells. In addition, hepatic glucose-6-phosphatase activity (Glc-6-Pase) was markedly reduced by CIE when compared to the control group. The authors concluded that the reduction in the hepatic Glc-6-Pase activity could decrease hepatic glucose production, which in turn results in lower concentration of blood glucose in CIE-treated diabetic rats. The effect of Cichorium intybus methanolic extract (CME) on glucose transport and adipocyte differentiation in 3T3-L1 cells was investigated by studying the radiolabelled glucose uptake and lipid accumulation assays. By performing detannification (CME/DT), the role of tannins present in CME on both the activitie`s was evaluated. CME and CME/DT exhibited significant glucose uptake in 3T3-L1 adipocytes with a dose-dependent response. CME inhibited the differentiation of 3T3-L1 preadipocytes but failed to show glucose uptake in inhibitor treated cells. The activity exhibited by CME/DT is exactly vice versa to CME. Furthermore, the findings from PTP1B inhibition assay, mRNA and protein expression analysis revealed the unique behavior of CME and CME/DT. Accordingly, the activities possessed by Cichorium intybus are highly desirable for the treatment of NIDDM because it reduces blood glucose levels without inducing adipogenesis in 3T3-L1 adipocytes. The direct action of soluble fibers (chicory water-soluble extract and inulin) was investigated on the intestinal absorption of glucose in gut perfused rats. After equilibrium, both jejunal and ileal segments were simultaneously perfused with an isotonic electrolyte solution (pH 7.4) containing glucose (10 mmol/l) and chicory water-soluble extract (chicory extract) or inulin (10 g/l). Each test or control solution was perfused in random sequence, with perfusion times of 30 min. Chicory extract or inulin in the perfusate (10 g/l) inhibited the absorption of glucose from jejunum (P degrees C; (2) filtration at 25 degrees C, and stored for 3 h; (3) boiled for 30 min at 102 degrees C, and then analysed. The antioxidant properties were evaluated in vitro as antioxidant activity (AA) (model system beta-carotene-linoleic acid) and ex vivo as protective activity (PA) against rat liver cell microsome lipid peroxidation measured as 2-thiobarbituric acid-reactive substances (TBA-RS) generated by peroxide degradation. All the vegetable juices showed high but very variable AA (> 83%) and PA (> 64%). After dialysis and analysis of fractions it was shown that the vegetable contained both biological antioxidant and prooxidant compounds. The prooxidants had MW < 3000, the most potent antioxidants compound (PA = 100%) had MW > 15000(115) . Statistically significant differences (p degrees C; (2) filtration at 25 degrees C, and stored for 3 h; (3) boiled for 30 min at 102 degrees C, and then analysed. The antioxidant properties were evaluated in vitro as antioxidant activity (AA) (model system beta-carotene-linoleic acid) and ex vivo as protective activity (PA) against rat liver cell microsome lipid peroxidation measured as 2-thiobarbituric acid-reactive substances (TBA-RS) generated by peroxide degradation.

- ***Ethnomedicinal Benefit of Chicory in Livestock Production***

The studies of Hassan et al. (2014) on the effects of different concentrations of chicory (Cichorium intybus) and wormwood (Artemisia absinthium) extracts against ovine gastrointestinal nematodes showed high effectiveness against ovine gastrointestinal nematode. The concentration of chicory extract (50 mg/ml) and wormwood extract (25 mg/ml) against adult Haemonchus contortus in vitro caused death of all the worms after 4 hours. Another study on anthelmintic effect of forage chicory against gastrointestinal nematode parasites established that feeding forage (70% of chicory DM) significantly reduces worm burdens and fecal egg counts of Ostertagia ostertagi in experimentally infected calves. Sesquiterpene lactones identified in both the fresh and silage chicory forage were suspected to contribute to the observed anthelmintic effects of dietary chicory. Scientific works by Milala et al. (2009) and other investigators posited that the polyphenolic acid of chicory roots expresses a wide range of health-promoting activities such as anticarcinogenic, anti-inflammatory, antiviral, antibacterial, antimutagenic, antifungal, anthelmintic, immune-stimulating, and antihepatotoxic activity and its antioxidant properties. Likewise, different researchers have submitted that chicory PSM can act against the Human Immunodeficiency Virus (HIV), protect the alimentary tract, and influence the reduction of serum cholesterol. Therefore, the supplementary or complementary inclusions of preparations rich in prebiotic saccharides and polyphenols produced from chicory can be used to promote the healthy properties of a diet and, at the same time, act as food and herbal medicament. A study asserted that chicory (C. intybus) is an herb that can be used as a source of fibre in pig diets. According to diverse groups of studies, chicory root is well known for its toxicity to internal parasites. It has since been reported that feeding inulin suppresses parasites such as Ascaris and Trichuris in pigs. The lowering of the intestinal pH, which is not favorable for the development of the parasite embryo, has been suggested as a possible mechanism. Two different studies established that ingestion of chicory by farm animals resulted in the reduction of worm burdens, which have prompted its widespread use as a feed supplement with a low fiber concentration. The total number of helminths in the abomasum of lambs grazed on chicory was reported to be remarkably reduced in the study conducted by Marley and coworkers, (2003).

Chicory also contains a low quantity of condensed tannins and sesquiterpene lactones which may affect protein utilization efficiency in ruminants and can as well reduce intestinal parasites in animals. It is also noted that sesquiterpene lactones in chicory extract inhibited the hatching of sheep's Haemonchus contortus eggs. Earlier, some workers reported that a dose-dependent anthelmintic action of extracts rich in condensed tannins and sesquiterpenes from C. intybus were indicated to reduce larval motility of lungworm and gastrointestinal nematodes, using a larval migration and inhibition assay. A study on pigs in Denmark [80] has shown chicory to have a positive effect on parasites and Lawsonia bacteria and it is relatively inexpensive but when used too much, it can cause a feeling of congestion in the digestive tract.

- ***Conclusion***

Cichorium intybus is grown and used in many parts of the world for various purposes. It is often used for its therapeutic and prophylactic quality, or for maintaining general wellbeing. As a very versatile plant, it is beneficial to both animals and humans due to its high amounts of proteins, carbohydrates, minerals, and phyto-bioactive elements. In livestock production, it has been noted that some of its phytoconstituents possess properties that improve the welfare of animals either in a parasitized state or otherwise. This makes chicory an ideal, cheap, natural, and sustainable livestock supplement or alternative feed material. However, caution should be exercised when chicory is included in diets or grazed by ruminants to prevent toxicity in high concentrations of PSM. Further research on the multipurpose properties of the phyto-bioactive elements found in chicory, their anti-nutritional effects, effective dose of inclusion in animal diets, mechanism of action involved, and the biochemical description of the active PSM is strongly recommended.